The Research Quarterly

of the

erican Association for Health and Physical Education

. VIII | DECEMBER, 1937 | No. 4

Published March, May, October, and December

ess: 311 Maynard, Ann Arbor, Michigan Subscription $3.00 per year

Entered as second class matter March 22, 1930, at the Post Office at Ann Arbor, Michigan, under the act of March 3, 1879.

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311 Maynard, Ann Arbor, Michigan
Subscription $3.00 per year — Single Copies, $1.00 each

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A Survey to Determine the Status of Graduate Work in Physical Education

By J. Anna Norris, M.D.
and Dorothy C. Sweet*
University of Minnesota

BECAUSE of the growing interest in graduate work in physical education and the increasing demand for it in institutions that do not now offer it, a survey was undertaken in 1937 at the University of Minnesota to discover what had already been done in this field by other institutions. Specifically, the data sought were the courses that are being offered for graduate credit, their points of difference from undergraduate courses, the degrees that are offered for advanced study in physical education, the training and experience of the instructors, and the number of students enrolled in graduate physical education courses.

In order to gain this information, questionnaires were sent to a group of universities and colleges whose graduate schools are known to have high standards and whose status in regard to physical education was not known, and to eleven others where graduate work in physical education is being offered. The first group, the basic list, is composed of the members of the *Association of American Universities* and twenty additional institutions suggested by the Dean of the Graduate School of the University of Minnesota. The supplementary list of eleven institutions not included in the basic list, known to offer graduate work in Physical Education, was obtained from a report by J. F. Rogers, M.D., and Stella T. Sebern, *Institutions Giving Professional Training in Physical Education and Health Education.* A copy of the questionnaire is appended to this paper. In order to assure ourselves of a complete report from each institution, blanks were sent to both the men's and women's departments, a total of ninety departments representing fifty-five schools.

THE STUDY

The returns on this questionnaire were very gratifying. Although the percentage of return on departments was only 79, the return on institutions was 93 per cent. After studying the reports, it was found that the departments for men and for women gave practically identical information since graduate courses in physical education are for the most part open to both men and women. This is possible as the work is

* Dr. Harl R. Douglass in the capacity of graduate adviser to Dorothy C. Sweet was of great assistance in organizing the study.

largely theoretical rather than practical. For this reason we feel that we have a good picture of 93 per cent of the schools contacted.

The growing interest and rapid development of graduate work in the field of physical education were clearly shown by the results of this questionnaire. The prompt response and cooperation received from so many directors of departments of physical education and their remarks expressing interest in the survey proved a real inspiration. One leader in the profession threw in a word of caution, however. He wrote, "Strong graduate schools are needed—not many. If there were four top-notch graduate professional colleges in the United States, it would be enough. East—Midwest—West and Pacific Coast. It would be a great boost for our profession." Three institutions say that in the face of the growing demand for graduate work in this field, they will offer the M.A. degree within the next two years. Two other institutions report that they have many students who do their graduate work in the departments of education, sociology, physiology, psychology, or philosophy, selecting courses and thesis topics which relate to the field of physical education.

In answer to the first question we obtained the following information: thirty institutions offer graduate courses in physical education; twenty-one do not. Four schools who did not reply are known to offer graduate work in physical education; so the total percentage of those who do offer graduate courses in physical education is at least sixty-two. The fact that over half of the outstanding graduate schools in the United States are giving graduate degrees with a major in physical education is especially significant when one considers that some of them do not have an undergraduate major in physical education. The percentage of institutions with undergraduate major departments that offer advanced degrees is therefore higher than sixty-two. Table I shows the percentage of returns and schools offering graduate work in physical education.

TABLE I

PERCENTAGE OF RETURNS AND SCHOOLS OFFERING GRADUATE WORK

Number of institutions included in the survey	55
Number of institutions responding	51
Percentage of response	93
Number of Departments of Physical Education included in survey	90
Number of departments responding	71
Percentage of response	79
Number of institutions offering graduate courses in P.E.	30
Number of institutions not offering graduate courses in P.E.	21
Percentage of 55 institutions offering graduate courses in P.E.	62

Unfortunately, not all the schools replied to the question concerning the number of students enrolled in graduate work in physical education. The twenty-five schools who did reply have a total of 1,032

students. Six reports offered the information that during summer sessions they have a much larger enrollment than in the regular year.

In the question concerning degrees offered, we attempted to differentiate between a Master of Arts and a Master of Science. The replies were not clear in several cases; so the results in Table II include both. Besides Master's degrees in Arts and Science it is possible to obtain a Doctor of Philosophy, Master of Education, or Doctor of Education with a major in physical education from several of the schools.

TABLE II

DEGREES OFFERED BY THIRTY INSTITUTIONS

22	(73%)	offer a Master's Degree with a Major in Physical Education
21*	(70%)	offer a Master's Degree with a Minor in Physical Education
11	(37%)	offer a Ph.D. Degree with a Major in Physical Education
10	(33%)	offer a Ph.D. Degree with a Minor in Physical Education
6	(20%)	offer a M.Ed. Degree with a Major in Physical Education
8	(26%)	offer a D.Ed. Degree with a Major in Physical Education

*Two schools offer a minor but not a major while three others do not offer a minor in physical education on the graduate level.

The fact that eleven schools included in this survey, ten of which are members of the *Association of American Universities*, offer a Doctor of Philosophy degree in physical education indicates that there must be opportunity and material for work of a high scholastic and research level in this field.

The returns on the check list showing who is eligible to take the courses offered for graduate credit in physical education seem to reveal no consistent practice by the institutions as to which courses carrying graduate credit are open to undergraduates as well as graduates. One might expect to find in the schools offering a Doctor of Philosophy degree in physical education more courses open to graduates only, but this does not appear to be the case. Of the eleven schools where a Doctor of Philosophy degree may be taken, five have over half of the courses open to graduates only while the other six have the majority of their courses available to undergraduates as well. Table III shows the distribution of courses open to graduates only.

TABLE III

DISTRIBUTION OF COURSES OPEN TO GRADUATES ONLY

No. of Institutions	No. of courses open to Graduates only	No. of Institutions	Percentage of graduate courses in Physical Education open to Graduates only
5	0	10	0– 20%
11	1– 5	6	21– 40%
8	6–10	8	41– 60%
5	over 10	2	61– 80%
		3	81–100%

On the whole, courses in physical education given for graduate credit are open to both men and women. We found that only three subjects were taught in separate classes for men and women by most schools and even these have some combined classes. They are courses in dancing, swimming, and athletics. The graduate courses in athletics are usually concerned with administration of intercollegiate, intramural, or Olympic athletics, and occasionally with advanced technique. The courses in dancing include advanced technique, composition, choreography, and theory. Occasionally other courses were found to be separate, but this seemed to be due to the arrangement of the departments rather than the nature of the course content.

Listed below in order of the frequency are the courses included in our list that were checked by over half of the schools:

Administration of Physical Education	26
Tests and Measurements	26
Problems in Physical Education	24
General Research in Physical Education	24
Health Education	23
Curriculum in Physical Education	18
Dancing	16
Recreation	16
History and Trends in Physical Education	16
Physical Therapy	15
Physiology	15

The courses that are open to graduates only in the majority of the schools are general research, problems, seminar, thesis, and methods of research.

The question concerning the degrees of the instructors of various courses was weak because from the information on the questionnaire it was impossible to tell how many individuals were being listed. If we had asked for the name of the instructor and the graduate courses each taught plus the degrees and years of experience, the information would have been complete and self-explanatory. It is difficult to draw any conclusions from this material as we now have it for the reason stated above, but we will include the results anyway. It appears from the figures in Table V that the majority of instructors of graduate courses in physical education hold Master's Degrees; also that the men instructors have more advanced degrees than the women with a much larger percentage of Doctors of Medicine among the men. However, anyone reading this is urged to keep in mind the possible inaccuracies of these results.

TABLE V

	B.S.	B.A.	M*	Ph.D.	D.Ed.	M.D.
Men instructors of grad. courses in P.E.	4	2	50	31	6	21
Women instructors of grad. courses in P.E.	4	3	69	10	1	2

*M stands for Master's degree, either M.A. or M.S.

Conclusions concerning the degree held by the instructor of the various courses are likely to be incomplete for the same reason. Those courses where the return was large enough to show a trend are listed in Table VI. The degree in column No. 1 indicates that in the majority of cases an individual holding that particular degree teaches the course; and column No. 2 shows the degree having the next largest representation.

TABLE VI

Courses	No. 1	No. 2
Administration of P.E.	M*	Ph.D.
Athletics	B.S., B.A.	M
Correctives	M	B.S., B.A.
Curriculum in P.E.	M	Ph.D.
Dancing	M	Ph.D.
Health Education	M	Ph.D. and M.D.
Fundamentals of Movement	M	M.D.
General Research in P.E.	Ph.D.	M
History and Trends in P.E.	M	Ph.D.
Hygiene	M	Ph.D.
Philosophy of P.E.	M	Ph.D., M.D., B.S.
Physical Therapy	M	
Physiology	M.D.	Ph.D.
Problems	M	Ph.D.
Recreation	M	Ph.D.
Seminar in P.E.	Ph.D.	M
Supervision	M	Ph.D.
Tests and Measurements	Ph.D.	M

*M stands for Master's degree, either M.A. or M.S.

On a separate sheet a statement regarding the kind of courses offered for graduate credit and how they differed from those offered for undergraduate credit was requested. From the answers on this question and the one concerning courses for which graduate credit is given, it was found that the majority of courses are open to both graduate and undergraduate students. The following is a list of methods or practices used by institutions reporting to make undergraduate courses worthy of graduate credit:

1. Student must make an A or B grade.
2. Additional assignments.
3. Higher quality of work demanded of graduates.
4. Extra reading, papers, individual problems.

The specific information on these practices given by the institutions may be generalized under the following twenty-two items:

1. Taught by specialists in specific field and holding advanced degrees.
2. Small classes—maximum number six to eighteen.
3. Syllabi and texts used less.
4. Higher standards.
5. Seminar type of class.
6. Committee work.
7. Emphasis on research and problem solving.
8. More discussions and argument.
9. "High class" papers in individual problems.

10. All courses theoretical rather than practical.
11. Less guidance to students.
12. Independent work—graduate suggests and develops own procedures.
13. More emphasis on field of general education.
14. Specialization.
15. Organization of curricula.
16. More individual instruction by teachers.
17. More individual investigation by students.
18. Original thinking and original production required.
19. Informal presentation of material.
20. Development of philosophy of physical education and materials offered to defend point of view.
21. Emphasis on areas of work, not on courses.
22. Emphasis on methods of work and problem solving rather than on factual information.

In a thought-provoking letter from one director in answer to this question, a list of abilities is given which should characterize graduate students. It is his feeling that graduate courses should be planned and presented in such a way as to best encourage the development of the following qualities as quoted from his letter:

1. Ability in self-direction and independence in work.
2. Knowing when, how, and where to secure expert opinion, guidance, and information.
3. Evidence of critical, analytical, and original thinking.
4. Creative work.
5. Evidence of organization and efficiency in work with especial consideration to written and spoken English.
6. Possession of the idea of working for results and not for credits or grades.
7. Working with a disregard of the number of hours "put in" and other evidences of unselfish and objective industry.
8. Professional maturity as evidenced by emotional stability, lack of prejudice, intellectual honesty, tolerance, etc.
9. Evidence of logical reasoning as opposed to rationalization in thinking.
10. Sense of social and professional responsibility culminating in a desire to make contributions to the profession and mankind.
11. A certain fearlessness with regard to securing and expressing the truth tempered by a sense of propriety and appropriateness.
12. A sense of progressiveness as indicated by healthy discontent and dissatisfaction with one's work.
13. Concentration and specialization without losing breadth of vision.
14. An appreciation of facts tempered by a recognition that the place and value of facts is sometimes more important than the facts themselves.
15. A certain disregard toward and fearlessness of the opinion of the mob.
16. A knowledge of the tools available in discovering facts with evidence of ability in using one or more of these tools effectively.

The foregoing lists include actual practices now in use and ideas and theories of those which the persons reporting would like to see in use, but practical limitations as well as teaching personnel very often determine the policies to be followed. The above director very aptly sums up the situation: "However, in the last analysis the individual instructor must understand these differentiating factors and be 'sold' to

such an extent that he will actually carry them out. I have found this is the most difficult part of offering and administering a graduate curriculum."

An attempt was made to compare the practices of the institutions on the basic list with those on the supplementary list. There appeared to be no significant differences. In order to know what is actually being done in the field of graduate work in physical education, one should analyze the contents of each course of study for every subject and the methods used in presenting that material. This could scarcely be done effectively without personally interviewing directors and instructors. However, if by such study it would be possible to standardize the work of graduate schools of physical education and maintain high standards, the improvement to our professional standing would be sufficiently great to make the trouble and expense worth while.

A QUESTIONNAIRE TO DISCOVER THE STATUS OF GRADUATE TEACHING IN PHYSICAL EDUCATION

SPONSORED BY THE DEPARTMENT OF PHYSICAL EDUCATION FOR WOMEN OF THE UNIVERSITY OF MINNESOTA

Do you offer any graduate courses in physical education? Yes......No......

(If you answer this question in the negative, there is no need of filling out the rest of the blank; however, please return the blank.)

Is it possible to obtain from your institution a *Master's Degree* (M.S....... M.A.......) with a major ......, a minor ...... in physical education; a Ph.D. with a major ......, a minor ...... in physical education? Other degrees:

Check those courses which you offer in the department of physical education for graduate credit and indicate whether they are for men, women, or both, and also whether for graduates only or for undergraduates as well. If there is more than one course under a given heading put under "Others."

Course in:	Open to Grad. Only	Open to Undergrad. and Grad.	Men Only	Women Only	Both
Administration of Physical Education					
Athletics					
Child Development					
Curriculum in Physical Education					
Dancing					
Plant (Facilities)					
First Aid					
Fundamentals of Movement					
General Research Work					

Course in:	Open to Grad Only	Open to Undergrad. and Grad.	Men Only	Women Only	Both
Health Education					
Hygiene					
Kinesiology					
Methods (General)					
Philosophy of Physical Education					
Physical Therapy					
Physiology					
Practice Teaching					
Problems					
Professional Preparation of Teachers					
Recreation					
Supervision in Physical Education					
Swimming					
Tests and Measurements					
History and Trends in Physical Education					
Others:					

What training and experience have the people who are teaching graduate courses in physical education? Indicate under the following headings as done in the example.

Instructor of:	Degrees	Years of Experience	Sex
Example: Dancing	B.S-M.A.	5	Female

....

....

....

Please send a catalogue which gives a brief description of graduate courses in physical education in terms of prerequisites, contents, or whatever is the custom of your institution; or list your graduate courses giving the same. (Use the reverse side of this sheet.)

How many students are registered in your institution this quarter or semester who are taking work toward an advanced degree with a major or minor in physical education? ....

A statement regarding the classification of courses as to graduate and undergraduate; in other words what kind of courses do you offer for graduate credit and how do they differ from those offered for undergraduate credit. Are there distinctive differences in the way in which they are taught?

Name of Institution: Location:

Signature of person reporting: Title:

Return to: Dr. J. Anna Norris, University of Minnesota, Minneapolis.

The Establishment of Bases for Classification of Junior and Senior High School Boys Into Homogeneous Groups for Physical Education

By J. W. Kistler, Ph.D.
State University of Iowa

THE PROBLEM

THE question of classifying has always been one of vital interest to those interested in educating by means of physical activity. Like their coworkers in other fields, the leaders in this phase of education have felt that the objectives of education in general and physical education in particular could be attained much more effectively under conditions where students participated in group activity with associates who were of at least approximately the same ability and experience.

The question has not been the need for and value in homogeneous grouping, but rather one of overcoming administrative barriers which stand in the way of such a procedure, as well as one of finding a classifying device which will make effective sectioning of the pupils possible, when all hindrances of the former nature are eliminated.

It is our purpose to discuss here the results of an attempt to find a device or a number of devices which might serve as effective tools for classifying junior and senior high school boys into homogeneous groups; assuming that these boys have been judged by medical authority as fit for the regular physical education classwork as we generally conceive of it.

Before we turn to this discussion, however, let us briefly review the results of other attempts to solve this problem.

REVIEW OF LITERATURE

Classification at the Elementary School Level.—At the elementary school level the factors of school grade, age, height, and weight have received major consideration in attempted classification for physical education activities. Incidentally, recent research appears to indicate that this approach to the problem has ample justification, as these items, excepting that of school grade, appear to be quite fundamental to the problem.[1]* Reilly,[2] Anderson,[3] McCloy,[4] and Cozens and Neil-

A paper presented before the Research Section at the National Convention of the A.P.E.A., St. Louis, Missouri, April 16, 1936.

*Indices refer to the Bibliography at the end of the article.

son[1] have all used them in combination with success as classifying devices.

Classification at the College Level.—At the college level, achievement scores have been used to quite a degree in the effort to classify the students according to their needs and abilities. Cozens,[5] Wayman,[6] Sargent,[7] Rogers,[8] McCloy,[4] Brace,[9] Schwegler,[10] Whipple,[11] Collins and Howe,[12] Garfiel,[13] Metcalf,[14] Kleeberger,[15] and Meylan[16] all have made contributions relative to this problem as involving college men and women.

Junior and Senior High School Classifying Devices.—We are primarily concerned in this discussion, however, with those classifying devices which have been especially planned for use in the junior and senior high schools.

A review of the literature reveals the fact that such devices are few in number. Brace has developed a scale of motor ability tests for use in measuring native motor ability of ages eight to eighteen.[9] This scale consists of twenty events in the nature of stunts which are easy to administer and score. McCloy has made studies of the relative contributions that chronological age, physiological age, school grade, height and weight make to the prediction of performance ability of boys in track and field athletics.[4] He proposes the formula, 20 age (in years) + 6 height (in inches) + weight (in pounds), as a classifying device for boys. The same authority also recommends the use of a battery of tests including the above described combination of age-height-weight, the Brace, the Burpee, and Sargent jump scores. These elements are weighted and a general motor capacity index number computed, to be used as a guide in classifying the pupil.[17] Rogers has worked out a classifying device based on the total score achieved in a strength test, which includes lung capacity, grip-, leg-, back-, and arm-strength.[8] He recommends its use for classifying boys, in particular, for competition in athletics. Johnson has devised a motor ability test of ten stunts involving ability in jumping, hopping, tumbling, etc., which he recommends as a classifying device.[18]

In summary, a review of the literature relative to classifying devices recommended for use in the homogeneous grouping of junior and senior high school pupils reveals the fact that such devices are few in number, and that those discussed in the literature give particular emphasis to the use of the factors of age, height, and weight in combination with strength, skill, native motor ability, and capacity.

PROCEDURE

Preliminary Investigations.—The writer made a preliminary study of this problem in 1933, a detailed discussion of which may be found in The Research Quarterly.[19]

The information gained as a result of this investigation was sup-

plemented by that obtained from a selected number of leaders in our field relative to the factors thought to be most worthy of consideration in classifying. According to the opinions of these experts, the factors of age-height-weight-build, strength, skill, health, personality, educability, and motor ability were judged, in the order named, to be most worthy of consideration.

Due to the fact that we felt available techniques for measuring personality were inadequate, and that the boys used in the study were judged by medical authority as physically fit for the program, the factors of health and personality were not considered in this investigation. An attempt was made to set up tests which would give a valid measure of all of the other items named, however.

Establishing the Criterion.—In establishing a criterion or standard by which to evaluate the classifying devices under consideration, the boys (120) used in the study were (1) subjectively classified by the writer into six homogeneous groups, (2) scored in track and field events, and (3) tested for skill in touch football, basketball, and softball activities. The three scores were standardized and given equal weighting to determine a composite criterion score for each individual.

In making the subjective classification of the boys, the writer attempted, after careful consideration of the individual's size, age, skill, aptitude, etc., to place him in one of six groups with others of like abilities.

Total points scored in four track and field events, the shot-put (8-lb.), 60-yard dash, standing broad jump, and the running high jump, as computed by McCloy's formula,[17] were taken as the second part of the criterion score. There is much evidence to support the thesis that ability displayed in track and field events is prognostic of athletic ability in general, hence the justification for including this score in our criterion.[4]

As stated above, the total score made in objective tests of skill in touch football, basketball, and softball was taken as the third element in our criterion. In touch football the boys were scored on kicking for distance and accuracy, passing, catching, and running with the ball. In basketball the tests included dribbling, basket shooting, and passing, while in baseball we tested for skill in batting, base running, catching fly balls, and fielding and throwing ground balls.

Selecting and Administering the Testing Items.—Thirty-one tests were selected for preliminary study. They were chosen on the basis of their estimated possibilities for measuring physical characteristics of an innate nature, as it was thought desirable to use events in which good performance did not depend upon past experience in the particular activity involved. The nineteen tests described below were chosen for final consideration.

Classification Index.—Computed by McCloy formula, 20 Age (years) + 6 Height (inches) + Weight (pounds).[4]

Chinning Strength.—Computed by the McCloy formula, 3.42 (number of chins) + 1.77 (weight) — 46.

Gripping Strength.—Equaled the sum of the right and left hand gripping strength.

Modified Brace Test.—Iowa revision of the original Brace test of motor ability used.[17]

Sargent Jump.—Distance in centimeters jumped above standing height used; instruction and practice given before testing; leap meter employed; six trials given.

Burpee Test.—Score equaled the number of times or fraction thereof the subject assumed the squat rest position, extended the legs to the front leaning rest, returned to the squat rest and stood erect in ten seconds; three trials given.

General Motor Capacity.—Computed by the McCloy formula, .1871 (classification index) + .8234 (Sargent jump in centimeters) + 2.2613 (Burpee test, 10 seconds) + .5269 (Brace test) — 182.[17]

Motor Quotient.—Computed by dividing the boy's achieved general motor capacity score by the norm for his classification index score.

60-Yard Dash.—Subject assumed any starting position he desired and started when he saw writer, who stood at the finish line with stop watch, drop his arm. The boy ran against time, was given three trials, and lowest score made was used.

Standing Broad Jump.—Subjects did jumping indoors upon a marked gymnasium mat; instruction was given as to arm swing, etc., and practice on side mats allowed; three jumps given and the best, measured in inches, taken as record.

Running High Jump.—Boys did jumping indoors, gymnasium mats were arranged so as to make landing as safe as possible. Two class periods were devoted to instruction and practice. Regulation jumping rules were followed in obtaining the boy's record, measured in inches.

Shot-Put.—One class period was devoted to instruction and practice in this event. Regulation rules were followed in testing and the eight-pound shot used. The puts were measured to the half foot. Each boy was allowed three puts.

Motor Achievement Quotient.—Computed by dividing the achieved motor ability score, as determined by performance in track and field events, by the norm for the individual's general motor capacity score.

Johnson Motor Ability Test.—Followed author's recommendations as to administering and scoring.[18]

Rogers Strength Index and Physical Fitness Index.—Followed procedure recommended by author.[8]

Standing Bar Vault.—Boys stood in front of horizontal bar gripping it with both hands. Without moving either foot from the floor preliminary to jumping, they vaulted, attempting to swing legs to one side and over the

bar while supporting the body upon their arms. Three trials were given at each height and the highest one legally cleared taken as the boy's score. Measurement was in inches.

Dodge Run.—The runner ran around five chairs, each 36 inches high and 16 inches wide, placed directly over points 15 feet apart vertically and 6 feet apart laterally. The start was made from a mark six feet to the right and fifteen from the first point, and the finish was made at a mark the same relative distance from the fifth point. The runner carried a soccer ball as he ran and was timed over the distance. Three trials were given and the low score taken as his best.

Shuttle Run.—Two parallel lines were drawn on the floor of the gymnasium ten yards apart, with similar intervening lines two yards apart. Boys started from behind one end line upon signal and ran to the opposite end line, touched the floor with either hand beyond the line, returned to the starting line and touched the floor beyond this line in a similar manner, then back to the opposite end line, etc., continuing for thirteen seconds. The score made equaled the number of two-yard zones traversed or entered during the time. Three trials were given and the best score made was used.

Evaluating the Tests.—Simple, partial, and multiple correlations were computed in the effort to determine the relative merit of the individual tests, as well as certain combinations of the same, as classifying devices. The results of our efforts are shown in the findings discussed below.

FINDINGS

TABLE I

THE NINETEEN TESTING ITEMS RANKED ACCORDING TO THE DEGREE OF THEIR CORRELATION WITH THE CRITERION

Testing Items	Ro.——	Testing Items	Ro.——
Shot-put	.897	Classification index	.787
General motor capacity	.871	Dodge run	.784
Standing broad jump	.840	Gripping strength	.778
Running high jump	.833	Sargent jump	.673
Rogers strength index	.827	Burpee test	.535
60-yard dash	.826	Modified Brace test	.460
Motor athletic quotient	.816	Johnson motor ability	.355
Standing bar vault	.812	Rogers physical fitness	.284
Shuttle run	.793	Motor quotient index	.175
Chinning strength	.792		

Study of the results of the first order correlations indicates in general that: (1) There is a relatively large number of tests which may be used effectively as classifying devices. Thirteen of the nineteen items show a coefficient of correlation of better than .750 with the criterion.

(2) Track and field events in particular appear to make good classifying tools as four such events are found among the first six ranking tests (3) The experts would appear to be justified in listing educability and strength in particular as important factors in classifying since these two items rank second and fifth, respectively, in the first order correlations. (4) Motor ability, at least as measured by the two recognized tests used in this study, is not of primary importance in classifying. (5) When quick, effective classification is the major consideration, the shot-put test would appear to be the choice of those considered in this study. (6) When additional supplementary information is desired, the general motor capacity test would probably have most to recommend it for such use.

TABLE II

THE THREE BATTERIES FOUND TO BE MOST EFFECTIVE FOR USE IN PARTICULAR SITUATIONS RANKED ACCORDING TO THE DEGREE OF THEIR CORRELATION WITH THE CRITERION

Number	Test Batteries			Ro.—
1. Dodge run	: Burpee test	: Shot-put	: Classification index	.934
2. General motor capacity	: Rogers strength index	: Shuttle run	: Standing broad jump	.924
3. Standing broad jump	: Burpee test	: Shuttle run	: Classification index	.920

Table II shows the three batteries of tests which have been selected as best suited for use as classifying devices in particular situations.

Battery No. 1 will be preferred when efficient classification of the boys is the major consideration. It is not difficult to administer and requires a minimum amount of equipment.

Battery No. 2 should be used when a maximum amount of information is desired about the boy. This battery requires time and equipment in administration, but will supply the teacher with valid information relative to the boy's age-height-weight-strength, physical fitness, motor ability, motor educability, and probable skill in athletics, track, and field events.

Battery No. 3 is probably best suited for all-round use. It will give effective classification and requires the minimum amount of equipment and time in administering. The Burpee test and the shuttle run can be given as group tests, while the standing broad jump requires very little time in scoring, as does the classification index score which may be figured at the convenience of the teacher from records easily obtained.

This battery has the added advantage of being composed of tests,

performance in which is relatively constant for the individual. Practice does not make an appreciable difference in the scores, since the tests measure qualities in which the individual soon attains his maximum performance, the limit of which appears to be fixed by his characteristics of a physiological nature. The result is that groups classified on this basis do not tend to become heterogeneous, at least as measured by the items of this battery.

TABLE III

FORMULAE SUGGESTED FOR USE IN DETERMINING CLASSIFICATION INDICES

Number	Formulae
1.	+ Burpee score + .5 shot put + .016 classification index — 4 dodge run.
2.	.4 General motor capacity + .03 Rogers strength index + 7 shuttle run + standing broad jump
3.	Standing broad jump + 6.5 Burpee score + 7 shuttle run + .2 classification index

The formulae shown in Table III are suggested for use in predicting the boy's classification score. The individual items of each battery have been given the optimum weighting in order to assure the most effective classification possible through the use of the device in question.

The teacher should first select the battery he wishes to use, administer the tests involved, and then score the boys by use of the corresponding formula. A range of classification indices will result which can be used to divide the boys arbitrarily into homogeneous sections to suit the particular situation in question.

CONCLUSIONS

1. Judging from the reports in the literature on the subject of classification, age-height-weight in combination, strength, skill in athletic events, and native motor ability appear to be the factors most frequently employed in this procedure.

2. According to the opinions of a selected group of experts in the field of physical education, age-height-weight-build, strength, skill, health, personality, educability, and motor ability are, in the order named, the factors judged to be most worthy of consideration in classifying.

3. The eight-pound shot-put appears to be the best single item test for classifying when effective grouping is the major consideration. In situations where additional information is desired about the boys, the general motor capacity test is to be preferred.

4. Track and field events in general rank high as classifying devices.

5. Strength and motor educability are factors most worthy of consideration in classifying.

6. Motor ability, as measured by the two recognized tests used in this study, is not of primary importance in classifying.

7. Judged from the standards of economy of time and equipment, effectiveness, and reliability, the battery composed of the items *Standing Broad Jump, Burpee Test, Shuttle Run,* and *Classification Index* would appear to be best suited for all-round use as a classifying device.

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The Floating Ability of Women

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As early as 1874 Pettigrew expressed the belief that since all humans are lighter than water, everyone can float in this medium if a relaxed supine position is assumed with the arms outstretched above the head, and if the breathing remains natural.[1]* After almost a quarter of a century of practical observation and scientific experimentation, the English investigators, Sandon and his son, concluded that floating cannot be achieved in fresh water if the specific gravity of the body is more that .9875, that all women have a density of less than this, and hence that all women can float.[2] The Sandons placed emphasis upon the necessity of a buoyancy sufficient to permit the exposure of the nose and mouth, which is essential for the continuance of respiration. In this discussion of the floating ability of women, the term is arbitrarily limited to the ability to remain in a motionless position, far enough out of water to permit breathing. Cureton sets unity as the critical limiting value and argues that anyone with a specific gravity of less than 1.000 can float.[3] Since all tissues except fat have a density of more than 1.000, Cureton believes that human floating must depend upon the general adiposity of the body and the amount of air in the lungs and hollow viscera. In so far as the Sandons' conclusion is contrary to practical experience this study was undertaken. Its object was to re-determine the floating ability of women and to explain why some assume a more horizontal position in the water than others.

METHODS

The experiment was performed on a homogeneous group of twenty-seven young adult women, all of whom were expert swimmers. None could be clinically classed as obese. Observations were made in an indoor fresh water swimming pool. The average temperature and specific gravity of the water were 26.25° C. and .998 respectively. Three factors affecting floating ability were considered: the specific gravity of the body, its buoyancy, and its equilibrium in water. The two latter were studied in back floating positions with full extension of the arms, the limbs resting naturally at the sides of the body, with complete flexion at the shoulder joints bringing the arms to a comfort-

* Numbers refer to Bibliography at end of article.

able posture elongated above the head, and in the same attitude with an additional wrist flexion carrying the hands out of water. Since

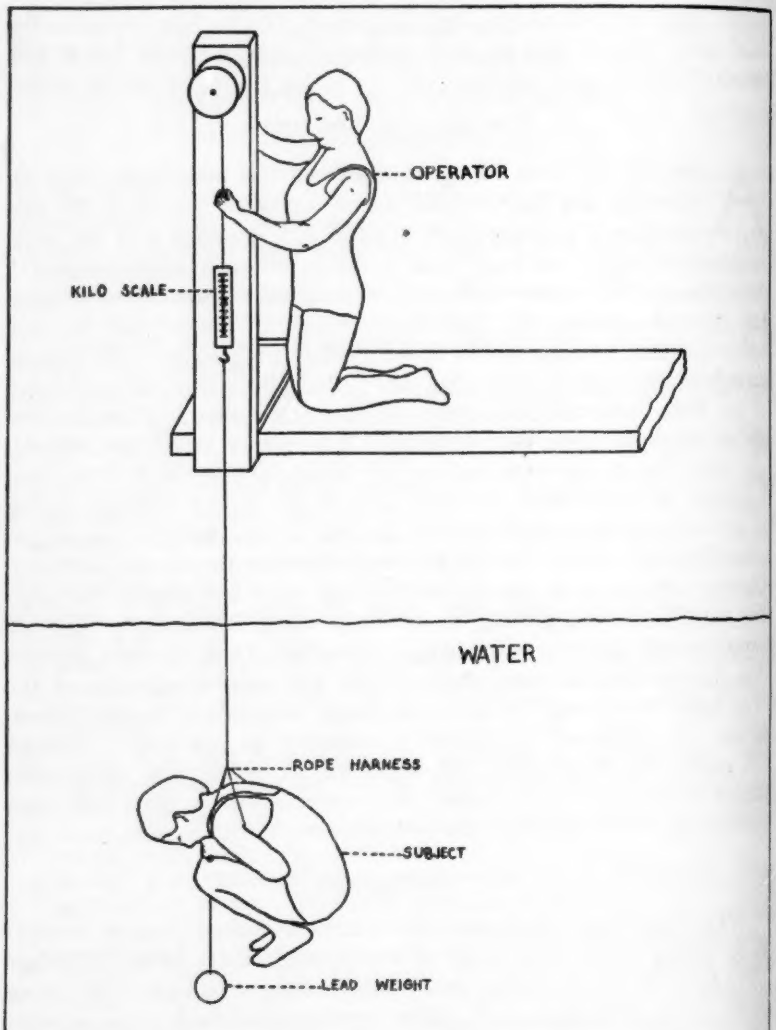

FIG. I.—Determination of specific gravity by Archimedes' Principle. The weight of the immersed subject is obtained by subtracting the submerged weight of the lead sinker from the reading registered on the kilogram scale. Knowing the weight of the subject on land, the specific gravity can be calculated by the following formula:

$$Sp.\,G. = \frac{\text{weight on land}}{\text{loss of weight in water}}$$

variations in pulmonary aeration greatly modify the results obtained, the subjects were carefully instructed to inhale maximally and hold the breath during each buoyancy observation.

1. *Specific Gravity.*—The method used for obtaining the specific gravity of the body is based on Archimedes' Principle and was similar in detail to that employed by the Sandons. It is schematically illustrated in Fig. I. When a body is immersed in water, its weight acting vertically downward is opposed by the upward thrust of buoyancy due to the displacement of water by that body, and it loses weight equal to the volume of liquid displaced. The subject, wearing a light harness attached to a spring scale, assumed a position in the water with the vertebral column, hip and knee joints strongly flexed, and taking the fullest possible inspiration, submerged with the aid of lead weights grasped between the knees. While suspended motionless, the immersed weight of the girl plus the lead sinker was read in kilograms on the spring scale. By subtracting the submerged weight of the sinker (3.7 kilos) from this value, the apparent loss of body weight in water was determined. The specific gravity was then calculated by dividing the weight of the body on land by the loss of weight in water. (Figure I.)

The subject could be submerged and weighed in less than twenty seconds. Before attempting this, breath holding time was determined following a maximal inspiration and after a maximal expiration. The object of this preliminary procedure was two-fold. Breath holding time is considered a rough test of cardio-vascular-respiratory efficiency and was thus a check upon the fitness of the subject for the performance of the experiment. Since in a vigorous young adult it exceeds twenty seconds by a comfortable margin, the subject was reassured concerning her ability to withstand the necessary submergence. The psychological effect of determining breath holding time was good. The specific gravity was first determined after the fullest possible inhalation. Then using a lighter sinking weight (1.7 kilos when immersed) the procedure was repeated, exhaling as completely as possible on the descent. Since breath holding time is now materially shortened, exhalation while sinking was found more satisfactory than deflating before submergence. As soon as the under water weight of the girl and the sinker was read, the subject was pulled to the surface of the water. The procedure is easily learned by the experienced swimmer but novices do not possess sufficient confidence to remain suspended and motionless under water. For the comfort of the subject, the fullest possible inspiration following a maximal expiration may be taken from a bag of pure oxygen instead of room air. This simple procedure increases breath holding time approximately 50 per cent, and a healthy young adult may then remain at ease without breathing for one and a half or two minutes.

2. *Buoyancy.*—Two factors act upon a subject immersed in water, buoyancy vertically upward through the center of the displaced liquid, and body weight vertically downward through the center of gravity. To float, the buoyant force must equal body weight in magnitude. For practical human floating, the body must displace a volume of water equivalent to its weight when a position enabling breathing is assumed. At least the face must be exposed.

To measure the buoyant force acting in the three horizontal positions, rope loops connected to the spring scale were fastened around each ankle just above the malleoli. The legs were lifted to the surface of the water and the force needed to maintain this position was determined. This method is illustrated in Figure II. The buoyancy of the body with the face and chest out of water, as is characteristic of back floating, is equal to the weight of the body minus the extra force necessary to support the legs. All determinations were made while holding the breath after a maximal inspiration.

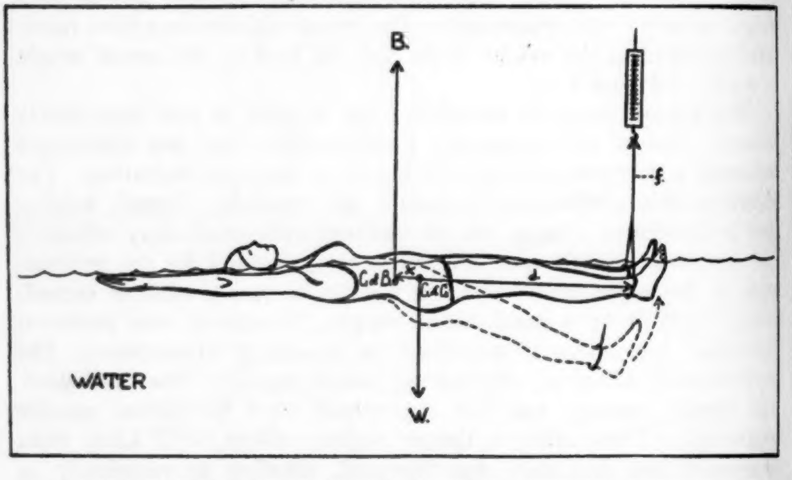

FIG. II.—An illustration of the method used for measuring buoyancy and for the location of the center of buoyancy in the horizontal floating position. The feet are raised to water level by shortening the cord attached to the ankle harness. The spring scale to which the cord is fastened records the force necessary to achieve this. Buoyancy is equal to the weight of the body minus the force needed to float the legs: $B=W-F$. Since the counterclockwise torque must equal the clockwise one: $Bx=fd$ or $x=\frac{fd}{B}$; B is bouyancy, d is the height of the center of gravity, f is the additional force needed to maintain a horizontal position, and x is the distance between the centers of gravity and buoyancy.

3. *Equilibrium.*—If the buoyant and weight forces do not operate in the same vertical plane, the body rotates until they directly oppose each other; equilibrium is then established when the center of buoy-

ancy is in line with the center of weight. The body floats in a horizontal position only when the plane containing both centers is perpendicular to its long axis.

To find the force tending to rotate the body when floating in a supine position it was necessary to locate the center of gravity and the center of buoyancy. The subject assumed a recumbent posture on the adjustable platform of a tilting board with the feet pressed firmly against a foot rest and the arms placed in each of the floating positions to be analyzed. The board, suspended on knife edges, was balanced by moving the counter-weighted adjustable platform, and the height of the center of weight from the soles of the feet was directly read in the plane of the fulcrum. To attain stability in water, the clockwise rotating torque must equal the counterclockwise one. Knowing the location of the center of gravity, the buoyancy, and the added force required to maintain the desired positions, the horizontal distance between the center of buoyancy and the center of gravity may be calculated, and the center of buoyancy determined. The rotating torques and the formula used for the calculation of the center of buoyancy are illustrated in Figure II.

The angle of flotation spontaneously assumed by each subject with the arms in the three positions being studied was observed and roughly gauged by sighting against a bar pivoted to a vertically fixed protractor. During this procedure, aimed at evaluating the floating ability, the subject breathed naturally. To obtain a picture of the respiratory characteristics, the basal tidal volume and rate of breathing were also determined. Large changes in pulmonary ventilation bring about correspondingly great variations in specific gravity and the subject rises and falls in the water in rhythm with her breathing.

RESULTS AND THEIR INTERPRETATION

The results obtained even upon experienced swimmers have only a suggestive value because the prime factor affecting specific gravity, buoyancy and equilibrium, is the quantity of air and gas in the various body cavities at the moment of weighing, and this variable of greatest significance in the experimental study of human floating is beyond simple and accurate measure. All observations were made upon the same day, and hence distortions due to changes in the quantity of gas in the hollow viscera and to the amount of adipose tissue in the fat depots of the body were eliminated. To check upon the completeness of inhalation and exhalation, vital capacity was indirectly determined from differences in the apparent loss of weight under the two experimental conditions, and compared with the vital capacity as measured out of water by the usual spirometer technique. In our subjects, as in the Sandons', many failed to inhale and exhale fully preliminary to the underwater weighing, but the results indicate that

the changes in pulmonary volume were roughly proportional to the vital capacity of the lungs. The derived data are summarized in Table I. In most instances, the greater the vital capacity, the lower the specific gravity, the correlation between these two variables being

TABLE I

THE RELATION OF BUOYANCY TO FACTORS KNOWN TO AFFECT FLOATING

Partial Correlations		Multiple Correlations	
Buoyancy and surface area	.88	Buoyancy, surface area, and vital capacity	.901
Buoyancy and vital capacity	.64		
Surface area and vital capacity	.55		
Buoyancy and specific gravity	—.31	Buoyancy, surface area, and specific gravity	.895
Vital capacity and specific gravity	—.68	Buoyancy, surface area, vital capacity, and specific gravity	.905
Surface area and specific gravity	—.20		

—.68. Whether the inhalation reached the fullest capacity of the lungs or not, the specific gravity as measured after a deep inspiration was low enough to permit all but one subject to float. The single non-floater with a density greater than that of water had the smallest vital capacity recorded. It is of interest to note that the vital capacity of this group of expert swimmers exceeded the predicted normal by an average of 11 per cent.[6] Only three had a vital capacity below their prediction by surface area, and the highest capacities exceeded the expected by 32 per cent. The mean vital capacity measured on expiration was 3.64 liters, being 3.33 liters when measured on inspiration.

The mean specific gravity after a full inspiration was .9812, ranging from .9635 to 1.0614. These values compare favorably with those obtained by previous investigators (Sandon,[2] Packard,[4] Cureton,[3] Spivak[5]). When the lungs were deflated, the average specific gravity was 1.0177. Only five subjects had a specific gravity of less than unity on full expiration. The lowest, .9675, was obtained on K. Z., who also had the lowest specific gravity on inspiration. This subject was the largest in the group. She was 176.3 cm. tall, weighed 95.185 kilos and had a surface area of 2.11 sq. m., the average for the group being only 1.68 sq. m. Her vital capacity was slightly in excess of 4 liters, which is not unduly large for her surface area, being only 2 per cent above her predicted vital capacity by this criterion. One may therefore conclude that her low specific gravity was due to adiposity.

With the arms hanging at the sides, only one subject had a buoyancy sufficient to remain in a horizontal position without an assisting

force. In all cases the buoyancy was increased by placing the arms above the head, and flexion of the wrist joints carrying the hands out of water augmented it further. Six subjects achieved horizontal floating unassisted in the latter posture. The legs of the remainder still had a tendency to sink because their weight exceeded the weight of the water displaced by this portion of the body.

Surface area was estimated from height and weight by the Du Bois formula: $A = H^{0.725} \times W^{0.425} \times 71.84$. It has a high positive correlation with buoyancy. In 1924 Sandon said that fat people are not necessarily better floaters than those of spare build.[7] This partially contradicts Cureton. The relation between adiposis and buoyancy is probably less significant in determining the floating ability of the average normal vigorous young adult than either vital capacity or surface area. A larger area of the body is exposed to the water when the arms are flexed than when they remain in the anatomical position, extended and held close to the sides. Hence the buoyancy is increased by this change in posture. Flexing the wrists so that the hands are out of the water when the arms are held above the head destroys a part of this buoyancy by diminishing the previously increased water contact area and the body is submerged deeper at the cephalic end to displace enough water to equal the weight; thus, the total upward thrust is increased but the center of buoyancy moves caudad. The elevation of the arms raises the center of gravity. Flexion at the wrist joints lowers it slightly, but the change in the center of weight is now not great because of the small weight of these anatomical parts. The mean height of the center of gravity in the three floating postures was 92.5, 98.56 and 98.41 cm. from the soles of the feet.

The shorter the lever arm between the center of gravity and the center of buoyancy, the less the inclination to rotate and the smaller the angle of flotation, measured in degrees from the horizontal. The centers of weight and buoyancy may deliberately be brought closer together by raising the center of gravity and lowering the center of buoyancy as already described. All subjects floated most horizontally with shoulder and wrist joint flexion, next best with the arms above the head and the hands in the water, and with least horizontality when the arms rested at the sides of the body. The data are presented in Table II, the mean values for the three positions being flotation angles of 15°, 29°, and 69° from the horizontal when the rotating torque was effective through levers measuring .521, .783, and 1.126 cm. respectively.

COMMENT

A high positive correlation exists between the multiple factors buoyancy, surface area, vital capacity, and specific gravity. Human floaters may be classed in two groups: (1) those who have a small specific gravity due either to adiposity or to a large pulmonary volume

or both; and (2) those who have a large surface area. Floating ability will be greatest when all three attributes are simultaneously present. This is exemplified by K. Z. who was the most "obese" (using the term relatively), who had the lowest specific gravity, a vital capacity above the average, and the largest surface area. She alone could float horizontally with the arms at the sides of the body. It is important when attempting to float to assume a position which favors maximum air in the lungs, thus keeping the specific gravity minimal. A "high" position of the chest during floating has long been advocated by swimming coaches. This is favored by strong extension of the vertebral column and complete flexion at the shoulder joints. If instead of breathing in a natural rhythm, the inspiration is made deep and held, and the expiration is hurried, the body, having to displace less water to equal its own weight, will remain higher on the water, thus allowing greater respiratory freedom. It is to be remembered that there may be no particular advantage in striving to attain a horizontal floating position if one can breathe comfortably while resting in a semi-vertical posture.

The principles presented are not new. This study merely clarifies the mechanism of phenomena long used as swimming aids by virtue of empirical experience. The evidence justifies the following conclusions:

1. Not all women can float in fresh water.

2. Anyone with a specific gravity of less than one and a body configuration which displaces enough water to equal its own weight can float.

3. If the volume of air in the lungs is increased, the specific gravity of the body is lowered and the floating ability is improved.

4. The angle of flotation depends upon the distance between the centers of buoyancy and weight.

5. The angle of flotation may be decreased by shortening the rotating torque.

Acknowledgments: Our thanks are due Miss Trilling and Miss Bassett who graciously placed the swimming pool of the Department of Physical Education at our disposal, Elizabeth Brogdon and Henrietta Thompson for assisting in the preliminary experimentation, Prof. Kelso for technical advice, and Miss Glassow for help in the statistical analysis of the data. To the subjects who so willingly withstood the discomforts of submergence, we wish also to express our appreciation.

TABLE II

THE RELATION OF THE ANGLE OF FLOTATION TO THE ROTATING TORQUE
C. of G. = Center of Gravity C. of B. = Center of Buoyancy

	Shoulder Extension		Shoulder Flexion		Shoulder and Wrist Flexion	
	Horizontal Dist. between C. of G. & C. of B.	Angle of Flotation	Horizontal Dist. between C. of G. & C. of B.	Angle of Flotation	Horizontal Dist. between C. of G. & C. of B.	Angle of Flotation
Subject	Centimeters	Degrees from Horizontal	Centimeters	Degrees from Horizontal	Centimeters	Degrees from Horizontal
1	.897	60	.684	10	.027	0
2	1.171	42	.97	30	.689	18
3	1.24	90	1.072	27	.666	19
4	.988	90	.666	50	.132	0
5	1.078	90	.656	27	.326	17
6	.464	0	.196	0	.048	0
7	.78	60	.5	27	.082	12
8	.992	60	.601	12	.149	2
9	1.15	90	.767	25	.549	13
10	1.319	63	.697	29	.138	8
11	1.475	65	1.145	39	.855	25
12	1.112	90	.682	44	.338	29
13	1.514	80	.805	46	.534	35
14	1.402	90	1.249	30	.828	12
15	.757	80	.656	27	.49	14
16	1.002	46	.810	16	.536	0
17	1.261	68	.955	37	.633	20
18	.805	80	.493	28	.368	19
19	1.517	53	1.313	26	.978	7
20	1.372	56	1.101	25	.852	16
21	1.003	52	.41	21	.136	0
22	1.316	44	1.096	27	.465	16
23	.834	60	.51	26	.127	0
24	1.24	80	.582	33	.144	10
25	1.12	90	.855	67	.566	23
26	1.557	90	1.055	28	.448	20
27	.994	90	.607	32	.301	18
Average	1.126	69	.783	29	.521	15

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Erroneous Measurements in the Field Events

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ALTHOUGH heights and distances achieved in field competition are customarily measured and recorded to the final eighth of an inch, it is common practice to overlook sources of error in measurement which may be so serious as to make the recorded figures wrong by many times the small fraction of an inch which represents their ostensible precision. World, Olympic, and local records sometimes change hands on the basis of performances which constitute such slight improvement over previous marks that the overlooked factors may well be conveying the honors to the wrong man.

It is not the intention of these lines to plead for an unattainable perfection. It is contended by the present writer, however, that the vitiation of the results of important competition by known and rectifiable errors is illogical, and that something positive should be done about it or else judges should cease to announce results such as 162 ft. 4⅞ in., which certainly imply that the distances achieved are known correctly with high accuracy. A few sources of error are discussed below which so far have received little or no attention from sports administrators, and in some cases suggestions for their remedy are offered.

EFFECT OF INACCURATE LEVELING

The surface upon which thrown weights land should be at the same level as the surface of the circle, but in actual practice considerable variation in these levels is tolerated and ignored. The effect of such variation is easily calculated. A well-thrown shot or hammer comes down at an inclination of about forty-five degrees to the horizontal. If it lands upon a surface which is two inches too high it is easy to see that its flight is shortened by just two inches. A discus travels to earth along a more nearly horizontal path, but a rough knowledge of the actual angle makes it possible to figure the effect of any particular leveling error as easily as in the forty-five degree case. Errors in leveling are most serious in the broad jump because of the very flat landing angle of the athlete—from twenty to twenty-five degrees. To increase a broad-jumper's leap by two or three inches it is only necessary to smooth off the pit at about one inch below the level of the take-off board.

One remedy for this illogical situation would be to pay attention to correct leveling. This has been done in a few cases, as for example in

the broad jump at the 1932 Olympic games where a planer, running on properly installed rails, scraped off the excess sand of the pit before each jump. Something of this kind could also be done in the case of the shot, but for the weights of longer range it would probably be regarded as impractical. To validate current measurements we should need leveling free from errors as large as an eighth of an inch, which is inches out of the question on turf and is not often obtained even on concrete tennis courts, as is shown by the distribution of puddles on such courts after a rain.

A simpler solution is to add to the surveying paraphernalia of the judges an ordinary surveyor's level and rod. The level is set up a few yards from the throwing circle and a preliminary reading is taken on the rod when the latter is in the circle. When measuring a throw the rod is placed on the mark made by the landing implement and another level reading taken. The apparent distance of the throw is measured as usual and a plus or minus correction based on the difference between the level readings is applied to it. This procedure simply changes the observed distance to what it would have been with accurately leveled ground, and this figure is certainly what should be recorded, though it may be inches away from the conventionally obtained distance.

EFFECT OF HARDNESS OF THE GROUND

This minor matter pertains especially to the shot and hammer. Athletic rules stipulate that measurements of weight throws are to be made from the rearmost point of the impression made on the ground by the landing weight. This rule makes a throw onto hard ground measure longer than one on a softer surface, since in the latter case the implement makes a larger depression, specifically one which extends farther in the backward direction.

Through this cause variations in hardness could at most influence the measured distance with the shot or hammer by as much as an inch, though in practice the resulting error is seldom more than half of this amount. With the larger sphere of the 56-pound weight, the error from this source is correspondingly larger. Errors of this type could be eliminated by the elaborate expedient of requiring a standard type of surface, or, more readily, by measuring the depth of the dent and applying a few simple calculations. To render measurements of weight throws as accurate as they purport to be, a combination of these methods would probably have to be worked out.

EFFECT OF VARIATION OF THE FORCE OF GRAVITY

The difficulty which one experiences in throwing a heavy weight depends upon where the feat is performed, for the downward pull of the earth upon any given object varies quite significantly from place

to place. This variation is a matter of latitude and altitude, objects becoming lighter as they are taken toward the equator or up to higher elevations. The magnitude of the effect is such that a man who puts the shot fifty feet at sea level in Norway will be able to add an extra three or four inches on a mountain at the equator, assuming identical form in the two cases. Entirely similar illustrations might be cited for the other thrown implements and for the jumps.

For these events every athletic field in the world may be regarded as possessing its own characteristic handicap, dependent upon the strength of the force of gravity at its location. Before field performances in one place may properly be compared with marks from another location, account should be taken of their relative handicaps. It is particularly illogical to discuss the adoption of world records without paying attention to this elemental principle.

Fortunately the force of gravity has been carefully measured at closely distributed spots all over the surface of the earth, and, as physicists and others in a position to discuss these matters will agree, the method of using gravity data for rendering athletic marks from different localities comparable is a particularly simple and reliable one.

EFFECT OF ROTATION OF THE EARTH

Though this list of erroneous practices might be further extended it will be concluded by mention of a final interesting and hitherto ignored minor effect. Because of the rotation of the earth on its axis a thrown weight follows a slightly different path in different latitudes, and even at a given spot the trajectory of a weight thrown, say, eastward differs measurably from that which it would follow if similarly projected toward the north, the west, or any other point of the compass. These effects are due partly to the fact that the moving earth gives the thrown projectile something of a push on its own account, and partly to the fact that the earth goes on moving while the weight is in the air and may be running away from the weight or coming to meet it, depending upon the direction of throwing.

Though these phenomena can be properly described only in technical language, their consequences are practical and definite. Artillerists in all the armies of the world have been aware of such effects for generations and have corrected the aim of long-range guns accordingly as a matter of regular routine. The effect upon athletic artillery is measurable. At the latitude of Los Angeles, for instance, a discus well-thrown in the eastward direction will travel about an inch farther than one similarly thrown to westward. Javelins, baseballs, and, in general, missiles of longer range will show the effect more conspicuously, but in the case cited the difference is enough to cause concern to anyone who is trying to measure throws correctly to a small fraction of an inch.

Apparently athletic administrators have entered into the business of

precise measurement without entirely realizing it, and without at all realizing the elaborate precautions which must be observed when anything at all is to be measured correctly to better than a tenth of one per cent. To undertake such tasks without the cooperation of physicists or other specialists in metrology is something like assuming the physical care of athletes without the aid of a physician. It is deceptive to keep up the appearances of accurate and comparable measurement in field events without striving to obtain the reality, and this can be obtained only by putting the matter on a scientific basis.

An Abstract of a Study of the Effects of Varying Degrees of Physical Activity During the Menstrual Period Upon the Red Blood Cell Count

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PROBLEM

The purpose of this study is to discover the effects of varying degrees of physical activity during the menstrual period upon the red blood cell count.

This problem involves the difference which might be found to occur between the normal red cell count for each subject and the menstrual counts of the same subject, and a further comparison of these differences according to the activity taken by the subjects during the menstrual period.

RELATED STUDIES

Although there is a wealth of published material on both the menstrual function and the erythrocyte count, there is little which is directly related to this investigation. No previous studies have been reported of the effects of activity during menstruation upon the red cell count; it has not been definitely established that there is a characteristic alteration of the count during menstruation although some investigators have submitted evidence which indicates such an alteration, usually a decrease from the normal.[1]

METHODS OF INVESTIGATION

Twenty-four girls were selected from the second-year class of the School of Education of New York University as subjects for the study. These girls were students in training for the profession of physical education. They were given physical and medical examinations and their health histories were studied. No outstanding abnormalities were discovered, but all deviations from the normal were carefully recorded for further investigation.

The subjects were divided into three groups and were instructed as follows:

The members of the Rest Group were to take no exercises during the entire period of menstrual flow except the exercise involved in getting to and from classes.

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[1] Emil Novak, *Menstruation and Its Disorders*, p. 93.

The members of the Restricted Group were to stop their activities short of fatigue during the entire menstrual period; they were also to refrain from engaging in any strong body twists or in jarring movements.

The subjects of the Active Group were to follow their usual daily program of vigorous activity.

The three groups were under daily observation. The subjects on each day of menstruation filled in forms (Daily Menstrual Report) reporting details of hygiene such as rest, sleep, activity, and diet, and also symptoms manifested such as pain, headache, colds, and fatigue.

The red cell counts were made between December first and May first. During this period a normal count was established for each subject by taking the mean of four counts taken during the intermenstrual interval. A menstrual count was made for each girl on every day during which there was a menstrual discharge.

The counts were made between the hours of eleven in the morning and one in the afternoon, during a class in physical education. Each subject's blood specimen was taken at approximately the same time of day on each occasion of testing in order that there might be no time variable and so that the amount of preceding activity might remain relatively constant.

The activity program which the students followed during the investigation included creative dancing, clog and tap dancing, apparatus work, tumbling, and basketball.

The technique adopted for the counting of red blood cells was the one commonly used.[2] The subject's right middle finger was cleansed with alcohol, dried, and punctured near the end. Pressure was exerted from the base of the finger downward and evenly on both sides. The first drop of blood was removed; from the second the blood was carefully drawn into the red blood cell pipette to exactly the point marked 0.5; the end of the pipette was then placed in a two and one-half per cent solution of potassium dichromate and the fluid was drawn up to the point marked 101, the pipette meanwhile being gently twirled in order to mix the blood with the diluting fluid, and a drop of the diluted blood was placed in the Neubauer counting chamber; the drop was covered with a glass, the slide placed on the stage of the microscope, and the cells allowed to settle.

The number of red blood cells in one cubic millimeter of the subject's blood was estimated by counting the cells found in eighty of the small squares marked on the counting chamber; those which touched the upper and left boundary lines were included in the count while those touching the lower and right boundaries were omitted; the following formula was applied to the resulting figures:

$$\text{Number of corpuscles per cu. mm.} = \frac{n \times 200 \times 4000}{80};$$

[2] C. E. McClung, *Handbook of Microscopic Technique*, p. 216.

n is the total number of cells in eighty squares; the capacity of each square in cubic millimeters is 1/4000.

FINDINGS

Means of red blood cell counts were obtained from the normal and menstrual records for each subject. These were compared and the differences between them were found (see Tables I to III).

Organization of the data was next made by groups. This included computing the means of the combined records for each subject of the Rest Group, for those of the Restricted Group, and for those of the Active Group (Table IV).

The differences between the normal and menstrual counts varied from an increase of 525,000 to a decrease of 530,000; however, the decreases occurred more frequently than the increases and there was an average decrease for each group; that of the Active Group was so small as to be almost negligible and after the refinement of the data by eliminating several extreme counts this difference appeared as an increase.

For purposes of analysis several cases suspected to be influenced by variables (hyperthyroidism, hyperadrenalism, and excessive intermenstrual interval) other than those under consideration were dropped singly and then altogether from the computations. After each of these eliminations it was found that the Active Group maintained the highest relative count during menstruation, the Restricted Group the next highest, and the Rest Group the lowest (Tables V and VI).

TABLE I

THE NORMAL AND MENSTRUAL MEANS OF THE COUNTS WITH THE DIFFERENCES FOR THE SUBJECTS OF THE REST GROUP

Subjects	Normal Mean	Menstrual Mean	Difference
One	4,610,000	4,392,222	217,778
Two	4,662,500	5,187,500	525,000*
Three	4,940,000†	4,894,444	45,556
Four	4,812,555	4,584,444	228,111
Five	4,695,000	4,385,833	309,167
Six	4,452,500	4,381,429	71,071
Seven	4,860,000‡	4,988,667	128,667
Eight	4,457,500	4,315,000	142,500*
Nine	4,950,000	4,710,000	240,000
Ten	4,520,000	4,446,250	73,750

* Difference representing an increase in menstrual over normal mean.
† With one count omitted this mean became 4,796,667 and the difference 97,777.
‡ A single count omitted this mean became 5,103,333 and the difference 115,000.

TABLE II

THE NORMAL AND MENSTRUAL MEANS OF THE COUNTS WITH THE DIFFERENCES FOR THE SUBJECTS OF THE RESTRICTED GROUP

Subjects	Normal Mean	Menstrual Mean	Difference
Eleven	4,440,000	4,608,750	168,750*
Twelve	4,437,500	4,390,000	47,500
Thirteen	5,612,500†	5,081,667	530,833
Fourteen	4,970,000	4,702,500	267,500
Fifteen	4,757,500†	4,340,000	417,500
Sixteen	4,347,500	4,733,333†	385,833*
Seventeen	4,960,000	4,585,000†	375,000

* Difference representing increase in menstrual over normal mean.
† Corrected for inconsistencies of one count these means were as follows:

Thirteen	(normal)	5,380,000;	difference 298,333
Fifteen	(normal)	4,560,000;	difference 220,000
Sixteen	(menstrual)	4,848,750;	difference 501,250
Seventeen	(menstrual)	4,678,000;	difference 282,000

TABLE III

THE NORMAL AND MENSTRUAL MEANS OF THE COUNTS WITH THE DIFFERENCES FOR THE SUBJECTS OF THE ACTIVE GROUP

Subjects	Normal Mean	Menstrual Mean	Difference
Eighteen	4,665,000	4,836,667*	171,667†
Nineteen	4,470,000	4,760,000*	290,000†
Twenty	4,760,000	4,543,333	216,667
Twenty-one	4,740,000	4,614,000	126,000
Twenty-two	4,897,500	4,761,000	136,500
Twenty-three ...	4,840,000	4,711,111	128,889
Twenty-four	4,430,000	4,345,000	85,000

* Corrected for inconsistencies of one count these means were as follows:

Eighteen	(menstrual)	4,480,000;	difference 185,000
Nineteen	(menstrual)	4,845,714;	difference 375,714

† Difference representing increase in menstrual over normal mean.

TABLE IV

THE MEANS AND DIFFERENCES OF THE COUNTS BY GROUPS, ORIGINAL AND REVISED

	Original	Revised
Rest normal mean	4,696,000	4,693,157
Menstrual	4,598,172	4,598,172
Decrease	97,828	94,975
Restricted normal mean ..	4,789,286	4,709,230
Menstrual	4,626,452	4,634,137
Decrease	162,834	75,093
Active normal mean	4,686,071	4,686,071
Menstrual	4,682,853	4,674,250
Decrease	3,218	11,821
Total normal mean	4,720,313	4,695,543
Menstrual	4,620,051	4,624,973
Decrease	100,262	70,570

TABLE V

THE NORMAL AND MENSTRUAL RED BLOOD CELL COUNTS WHEN FACTORS OTHER THAN MENSTRUATION ARE RULED OUT

	Rest	Restricted	Active
Hyperthyroids omitted			
Normal	4,679,117		4,601,250
Menstrual	4,599,523		4,666,363
Difference	79,594		65,113*
Hyperadrenals omitted			
Normal	4,684,285		4,689,583
Menstrual	4,566,309		4,684,473
Difference	117,976		5,110
36-day interval omitted			
Normal	4,696,764		
Menstrual	4,542,588		
Difference	154,176		
All above omitted			
Normal	4,668,578		4,580,000
Menstrual	4,489,701		4,685,000
Difference	178,877		105,000*

* Difference representing increase in menstrual over normal mean.

TABLE VI

A RANKING ACCORDING TO THE DIRECTION AND DEGREE OF THE VARIOUS DIFFERENCES FOUND BETWEEN THE MEANS OF NORMAL AND MENSTRUAL COUNTS OF THE THREE GROUPS*

Dif.	Rest	Rank	Restricted	Rank	Active	Rank
A.	97,828	(2)	162,834	(3)	3,213	(1)
B.	94,975	(3)	75,093	(2)	11,821	(1)
C.	79,594	(3)	75,093	(2)	65,113†	(1)
D.	117,976	(3)	75,093	(2)	5,110	(1)
F.	154,176	(3)	75,093	(2)	11,821	(1)
G.	178,877	(3)	75,093	(2)	105,000†	(1)

* The above table is read as follows:

A is the difference found when all cases are included (see Table IV), B is the difference when single inconsistent counts are omitted (see Table IV), C is the difference when the hyperthyroid cases are omitted (see Table V), D is the difference when the hyperadrenal cases are omitted (see Table V), F is the difference when the case of excessive intermenstrual interval is omitted (see Table V), and G is the difference when the single inconsistent counts, hyperthyroid cases, hyperadrenal cases, and the case of excessive intermenstrual interval are all omitted (see Table V). A ranking of *one* indicates the smallest decrease or an actual increase from normal to menstrual count.

† While all other differences indicate a decrease in the menstrual counts, these two represent increases in the menstrual counts over those of the normal.

SUMMARY OF FINDINGS

1. The number of red blood cells was found to either increase or diminish during menstruation in accordance with certain characteristics of the individual.

2. In the majority of cases a decrease was found in the menstrual count.

3. Hyperadrenalism appeared to cause a lessened decrease or an actual increase in the menstrual count.

4. Hyperthyroidism appeared to cause an exaggerated menstrual decrease.

5. A greatly lengthened intermenstrual interval appeared to be associated with an increased count during menstruation.

6. Undiscovered factors may have been at work in determining the extent of difference in the menstrual count.

7. Seasonal variation of red blood count was indicated with a cumulative decrease throughout the period studied.

8. The red blood cell count for the majority of individuals reached the lowest point during menstruation on either the fifth or sixth day if menstruation persisted for that length of time.

9. Some indication was given that activity, either vigorous or modified, was related to a day-to-day variation during menstruation which occurred in regular rhythm but in which the low counts were not less than the menstrual counts exhibited by the non-active subjects.

10. The Rest Group exhibited a daily decrease of count during menstruation which approximated constant.

11. Accustomed vigorous activity was more conducive to high menstrual count than was modified activity or an elimination of activity.

12. Restricted or modified activity was slightly more conducive to the maintenance of a high menstrual count than complete abstinence from physical activity.

13. Of the three groups studied the Active Group maintained, relatively, the highest count, the Restricted Group ranked second, and the Rest Group third.

14. In the maintenance of a high red blood cell count, activity during menstruation is desirable for those accustomed to activity.

CONCLUSION

From the investigations made under the conditions previously described it was concluded that:

Participation in physical education activities during menstruation contributes toward maintaining or increasing the normal red blood cell count when the subjects concerned present no abnormalities in physical condition and are trained in such activities.

SIGNIFICANCE

Such a conclusion might seem to substantiate continuance of the activity program during menstruation, but other evidence must be at hand before such a recommendation can be made with assurance. Many other phases of the problem must be investigated before a complete picture of the effects of activity during menstruation can be presented.

Body Mechanics Analysis of Yale University Freshmen

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INTRODUCTION

IN RECENT literature the term "body mechanics" has been used in preference to the term "posture" because of its broader scope, with major emphasis on the proper analysis of the individual and a scientific prescription of corrective exercises suitable for the needs for which they are intended. The Subcommittee on Orthopedics and Body Mechanics of the White House Conference on Child Health and Protection suggests the former term as being more inclusive and descriptive, and defines body mechanics as the mechanical correlation of the various systems of the body with special reference to the skeletal, muscular, and visceral systems and their neurological associations.[1]

Much interest has been manifested in the body mechanics program as carried on at Yale University. Originating in the fall of 1919 through the efforts of Dr. J. C. Greenway, at that time Director of the Yale University Department of Health, the system has grown rapidly under the direction of R. J. H. Kiphuth, who is responsible for popularizing the term "body-building" with particular emphasis on correct body mechanics.

It is the purpose of this report to present, first, the subjective examination of the individual made by an orthopedic surgeon at which time the postural defects are determined; and, second, the objective examination of the individual made from a posture photograph. It is from the latter that quantitative evidence is secured for future comparison. It is felt that through this combined approach more intelligent guidance can be rendered the student in correct body mechanics.

ORTHOPEDIC EXAMINATION

At the beginning of the fall term each member of the incoming freshman class is sent a post card requesting him to report to the Payne Whitney Gymnasium at a designated time for a complete orthopedic examination. At this time the student fills out his activity record and also has his height and weight, without clothes, recorded on the

[1] R. B. Osgood, *Body Mechanics, Education and Practice,* (New York: D. Appleton-Century Co., 1932) p. 5.

examination card which he then takes with him to the examination room. Here the student stands in parallel footprints drawn upon the floor, with the inner borders three inches apart. He assumes his best standing posture with eyes fixed straight ahead and is ready for examination by the orthopedic surgeon. The doctor judges approximately the anteroposterior and lateral deviations and arbitrarily divides them into four degrees of measurement: ideal, 1st, 2nd, or 3rd degree variation. The rating of the student is noted on the examination card which lists the most common postural defects.

Based upon these findings each member of the class is placed in one of the following groups:

Group I—Men having ideal posture.

Group II—Men having mild defects (1st degree) which are not considered serious enough to require corrective measures.

Group III—Men having moderate defects (2nd degree) who are assigned to gym work for correction.

Group IV—Men having marked defects (3rd degree) who are given individual attention.

A detailed account of the procedures followed by the doctor in his orthopedic examination and items upon which his judgment is based may be found in the book by Phelps and Kiphuth.[2] All structural and pathological cases are referred to the Health Department for further diagnosis and treatment.

OBJECTIVE EXAMINATION FROM POSTURE PHOTOGRAPH

Many investigators have sought to evaluate posture using various devices and schemes. In recent years photography has been of great value in recording physical defects. Extensive research has been carried on at Wellesley College in the development of an objective posture grading scheme for women, while Springfield College has done much work in the development of technique for objectively grading the posture of men. As part of an investigation in physical development and posture, Schwartz, Britten, and Thompson devised eighteen separate measurements concerned with an analysis of various angles of the body made directly on the photograph.[3]

Since the inauguration of corrective work at Yale University a photograph has been taken of the student in the anteroposterior plane. This means of recording the posture of the individual has been used in place of the ordinary silhouette which blots out many significant features of the body form, and is not as personal as the photograph. An additional photograph of the back is taken of individuals having a lateral curva-

[2] W. M. Phelps and R. J. H. Kiphuth, *The Diagnosis and Treatment of Postural Defects*, (Baltimore: C. C. Thomas, 1932) pp. 78–125.

[3] Louis Schwartz, R. H. Britten, and L. R. Thompson, "Studies in Physical Development and Posture," Public Health Bulletin, No. 179, (Washington: U. S. Public Health Service, June, 1928); Public Health Bulletin, No. 199, (March, 1931).

ture of one-half inch or more. It has only been during the past two years that any attempt has been made to determine objectively anteroposterior spinal curvature or segmental alignment from the picture. There seemed to be a definite need for accurate objective measurements of the body mechanics of the incoming freshman for the following reasons:

1. To motivate the student and make him posture conscious.

2. To collect quantitative evidence showing the exact effect of corrective exercises.

3. To render more efficient follow-up work throughout the four years of college life.

4. To secure data for building body mechanics norms of Yale University students.

CENTER OF GRAVITY TEST

Preliminary to taking the photograph, the student's center of gravity in the anteroposterior plane is determined by the use of the center of gravity apparatus reported upon by Cureton and Wickens.[4] The reading of the weights is greatly facilitated by use of Toledo dial scales in place of the lever arm type. (Figure I.) This is a static test showing how the person stands with respect to leaning forward or backward from the ankle joints. It also has other implications as a test of condition as reflected through posture.

THE POSTURE PHOTOGRAPH

Before the student is photographed, specific points on the left side of the body are marked with a black flesh pencil in order to serve as landmarks for determining segmental alignment on the picture. The following points are used: tragus of the ear, front tip of the shoulder, acromion, greater trochanter of the femur, styloid process of fibula, and center of the external malleolus. In order to determine the amount of anteroposterior spinal curvature five aluminum pointers are attached to the back by means of one-inch strips of "Drybak" white adhesive tape.[5] These pointers are located at the spinous process of the 7th cervical vertebra, the greatest convexity backward of the dorsal curve, the point of inflection, the greatest concavity backward of the lumbar curve, and the most prominent part of the sacrum. One pointer is placed at the lower end of the sternum to determine carriage of chest. In some cases where it was obvious that the flesh pencil mark on the acromion would not show in the photograph another pointer was placed at this point to

[4] T. K. Cureton and J. S. Wickens, "The Center of Gravity in the Anteroposterior Plane and Its Relation to Posture, Physical Fitness, and Athletic Ability," Supplement to the RESEARCH QUARTERLY, 6 (May 1935), pp. 93–105.

[5] The writers are indebted to Elizabeth Powell of Wellesley College who very kindly supplied several sets of aluminum pointers.

FIGURE I

aid in the study of the shoulder position. The student is then asked to step into parallel footprints painted on the floor with the inner borders three inches apart. The feet are adjusted so that a plumb-bob falls through the external malleolus. The plumb-bob is of value in the study of segmental alignment and body lean as well as serving as a guide when drawing lines on the photograph. The anteroposterior photograph is then taken, after which the pointers are removed and the flesh pencil marks eradicated.

SCALING OF PHOTOGRAPH

After the negative has been developed and the picture printed, the various measurements are determined. As the pointers are of a known length, it is possible by measuring inward the proper distance from their tips to locate the point of attachment which is otherwise invisible in the picture because of projecting scapulae, heavily developed posterior muscles, or position of arm or elbow on side facing camera. A pair of bow dividers are used for this procedure and a small perforation is made at

the point of attachment. A small perforation is also made through the flesh pencil marks as well as at the fleshline of the most protuberant part of the abdomen. The glossy side of the picture is placed face down on the glass surface of a mimeoscope which is illuminated from underneath thus causing the picture to be transparent. It is then possible to make all of the measurements on the back of the photograph. Lines are drawn with a No. 7 hard pencil. Angles are measured with a protractor, while linear measurements are read in millimeters from a vernier caliper.

Head and Trunk.—The position of the head and neck is determined by scaling the angle made by a horizontal line through the 7th cervical and a line from the 7th cervical through the tragus of the ear (Figure II). This is similar to the measurement reported upon by Cureton, Wickens, and Elder in the Springfield Study.[6] The 7th cervical serves as a relatively immovable landmark with respect to the head. As the head and neck is thrust forward or backward varying the position of the tragus, it is obvious that there is a change in the size of the angle. In the case of "poke neck" the angle is smaller as compared to the head being carried in a retracted position when the angle becomes larger.

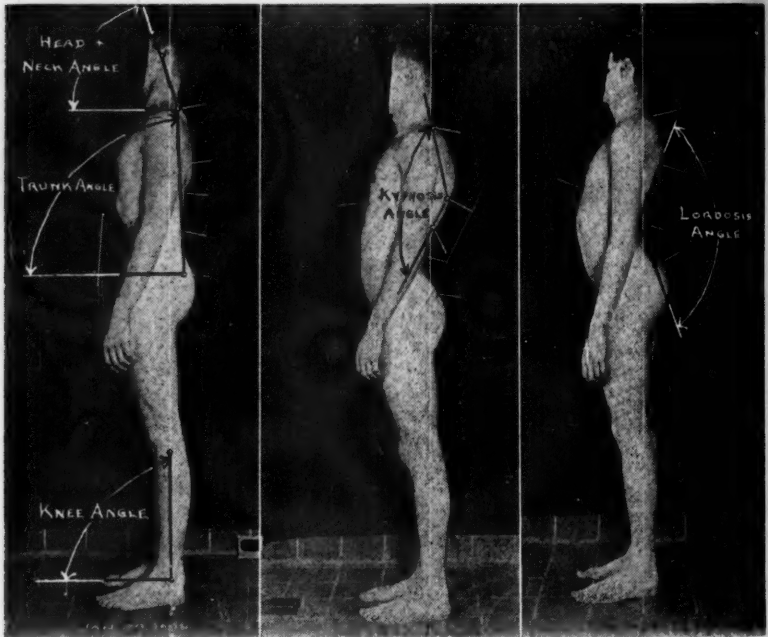

FIGURE II FIGURE III FIGURE IV

[6] T. K. Cureton, J. S. Wickens, and H. P. Elder, "Reliability and Objectivity of the Springfield Postural Measurements," Supplement to the RESEARCH QUARTERLY, 6 (May 1935), p. 86.

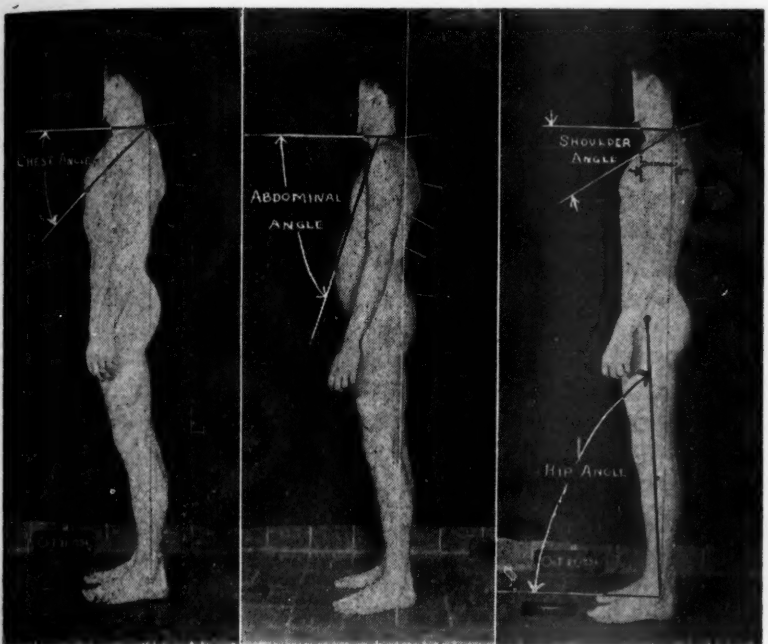

FIGURE V FIGURE VI FIGURE VII

Kyphosis.—The condition of the upper and lower back is an important item in the routine body mechanics examination, especially with regard to deviation from the so-called normal physiological spinal curves. The method herein described takes into account the more essential points of the curves and gives consistent results which distribute in a good binomial curve. The amount of kyphosis is determined by scaling the angle made by a line from the greatest convexity backward of the dorsal curve through the 7th cervical and a line from the greatest convexity backward through the inflection point as shown in Figure III.

Lordosis.—The lordosis angle is formed by a line from the greatest concavity backward of the lumbar curve through the inflection point and a line from the greatest concavity backward through the most prominent part of the sacrum. (Figure IV.)

In the measurement of the upper or lower back, the straight spine will give an angle approaching 180 degrees. As the curvature is increased, the angle becomes smaller. When an individual has a reverse curve, that is, a hollow in the dorsal region and a prominence in the lumbar region, the reading will be more than 180 degrees.

Chest.—It is generally accepted that the habitual position of the chest should be that about half-way between full inspiration and com-

plete expiration. As the chest is elevated on inspiration it enlarges from front to rear as well as laterally. The front of the chest and sternum is carried upward and away from the spinal column. On the photograph the angle formed by a horizontal line through the 7th cervical and a line from the 7th cervical through the end of the sternum gives a measure of the carriage of the chest. (Figure V.) Men carrying their chests in an elevated position show a smaller angle than individuals having a flat chest.

Abdomen.—An idea of how the abdomen is carried relative to the chest may be determined easily on a photograph. If the abdominal line is straight and does not extend beyond the sternum then the angle formed by a line from the most prominent part of the abdomen through the end of the sternum and a horizontal line through the 7th cervical will be 90 degrees or greater. On the other hand, if the abdomen extends beyond the sternum, the angle will read less than 90 degrees. (Fig. VI.)

Shoulders.—Shoulder forward is a relatively difficult item to measure. At the present writing, angle and linear measurements similar to those used at Springfield have been tried.[7] As the shoulders cannot be measured relative to the head because both are very movable, the 7th cervical and forward tip of shoulder have been selected as landmarks. The shoulder angle is determined by scaling the angle made by a horizontal line through the 7th cervical and a line from the 7th cervical through the front tip of the shoulder.

Measuring with vernier calipers the horizontal distance between two vertical lines erected through these points gives a linear rating of shoulder forward. (Figure VII.)

Trunk.—An important item in segmental alignment is the lean of the trunk forward or backward as it is balanced on the hip joint. The term overcarriage is applied in faulty carriage of the trunk where its weight is carried backward so that a vertical through the 7th cervical falls outside the most prominent part of the sacrum.

This may be objectively measured using the angle formed by a horizontal line through the sacral point and a line from the sacral point to the 7th cervical. As the trunk leans forward the angle becomes less than 90 degrees while in overcarriage it increases from 90 degrees. (Figure II.)

Hips.—The position of the hips is measured by the degree the greater trochanter of the femur is carried forward or backward relative to the external malleolus. In the case of forward thrust the angle formed by a horizontal line through the external malleolus and a line from the external malleolus through the greater trochanter of the

[7] *Op. cit.*, p. 87.

femur is less than 90 degrees, while in hip thrust backward the angle becomes greater than 90 degrees. (Figure VII.)

Knees.—Although "bow-legs" or "knock-knees" cannot be determined from a picture taken in the anteroposterior plane, an idea of knee posture with regard to "flexed knees" or "hyperextended knees" may be obtained by scaling the angle formed by a horizontal line through the external malleolus and a line from the external malleolus through the styloid process of the fibula. (Figure II.) In cases of flexed or "easy" knees the angle will be less than 90 degrees, with hyperextended knees greater than 90 degrees.

VALIDITY OF THE METHOD

In order to validate thoroughly the method used in the analysis of the photographs, much experimentation was carried on to determine the degree of precision of the more significant measurements. Where possible this method was compared with other objective posture grading methods by intercorrelating statistically the more significant items. The Pearson product-moment method of correlation was employed.[8] All correlations reported herein are zero order correlations and have not been corrected for attenuation.

I. The combined reliability and objectivity coefficients were determined for the significant postural items. Thirty subjects were photographed and then rephotographed after the pointers were affixed by two different examiners independent of each other. In several cases there was an interval of 2 to 3 days between photographs. The following coefficients show the precision of affixing the pointers and scaling of picture as well as the variability of the posture:

Head and Neck	$r = .721 \pm .054$
Kyphosis	$r = .854 \pm .034$
Lordosis	$r = .730 \pm .053$

II. Duplicate sets of one hundred pictures (5″ x 7″) were graded by two different examiners. The measurements intercorrelated as follows:

Head and Neck	$r = .962 \pm .006$
Kyphosis	$r = .956 \pm .007$
Lordosis	$r = .966 \pm .006$

III. Fifty of the 5″ x 7″ negatives were enlarged four times their original size by an auto-focus enlarger. The position of each of the pointers was traced and the angles were measured in order to determine whether the measurements would be influenced by the size of the photograph. The measurements on the enlargement intercorrelated with those from the original size as follows:

[8] H. E. Garrett, *Statistics in Psychology and Education*, (New York: Longmans, Green and Company, 1932), pp. 163–172.

Head and Neck	$r = .945 \pm .012$
Kyphosis	$r = .979 \pm .006$
Lordosis	$r = .970 \pm .006$
Chest	$r = .975 \pm .006$

IV. A wooden conformateur was constructed consisting of an upright attached to a base.[9] Holes were bored horizontally through the upright through which wooden rods would slide and contact the spine as the subject stood on the apparatus and assumed his best standing posture. At first, seventy-four subjects were photographed with the conformateur and then with aluminum pointers. In the case of the spinal curves, angle measurements similar to those used with the pointers were applied to the corresponding points on the conformateur rods. The following coefficients were obtained:

Head and Neck	$r = .666 \pm .046$
Kyphosis	$r = .762 \pm .035$
Lordosis	$r = .862 \pm .022$

The number of cases was increased to one hundred thirty-three with the following results:

Head and Neck	$r = .619 \pm .035$
Kyphosis	$r = .786 \pm .024$
Lordosis	$r = .838 \pm .018$

The angle measurement of kyphosis taken on the conformateur was then intercorrelated with kyphosis measured across specific arcs on rods by scaling with vernier calipers as done at Springfield.[10] The same was done with lordosis. The coefficients being:

Kyphosis	$r = .90 \pm .011$
Lordosis	$r = .841 \pm .016$

V. While the combined reliability and objectivity coefficient of the shoulder measurement is fairly high:[11]

Angle measurement	$r = .825 \pm .029$
Linear measurement	$r = .877 \pm .022$

it is evident that the angle measurement is influenced to some extent by the slope of the shoulders. These two measurements when intercorrelated give a coefficient:

$$r = .233 \pm .062 \text{ (86 cases)}$$

This item is still being investigated as there is need for an improved method for recording round shoulders.

VI. The chest posture as measured by the angle used in this study was compared with Kellogg's chest ratio,[12] the relationship being very low:

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[9] T. K. Cureton, "The Validity of Anteroposterior Spinal Measurements," RESEARCH QUARTERLY, 2 (Oct. 1931), p. 105.

[10] *Op. cit.*, p. 89.

[11] *Op. cit.*, p. 87.

[12] J. H. Kellogg, "Observations on the Relationship of Posture to Health and a New Nethod of Studying Posture and Development," *Bulletin of Battle Creek Sanitarium and Hospital Clinic*, 21 (Sept. 1927), pp. 193–216.

$r = .078 \pm .094$ (50 cases, chest normal)
$r = .135 \pm .092$ (50 cases, chest expanded)

Kellogg's chest ratio was also compared with an angle formed by a vertical through the sterno-clavicular notch and a line from this point through the end of the sternum. This coefficient was also low:

$r = .202 \pm .091$ (50 cases, chest normal)
$r = .200 \pm .091$ (50 cases, chest expanded)

The anterior and posterior angles as used in Kellogg's method seem to be influenced to some extent by the leaning of the trunk forward or backward upon the hip joint. This is shown in part by the relationship between these two items:

$r = .577 \pm .062$ (50 cases)

It is evident that the two angle measurements of the chest investigated in this study and mentioned above are not influenced by trunk lean. The size of the angles definitely depends upon the carriage of the chest. When these two measurements are intercorrelated:

$r = .76 \pm .041$ (50 cases, chest normal)
$r = .91 \pm .018$ (50 cases, chest expanded)

VII. Interesting results were obtained on comparing some of the items mentioned in this report with measurements secured by following some of the techniques employed at Wellesley College where posture grades are obtained from photographs taken during the routine physical examination. Wellesley was the first to use aluminum pointers as an aid in studying spinal curvature and segmental angulation and has thoroughly investigated the validity and precision of its method.[13] The pointers are located at the dorsal process of the 7th cervical, the 2nd 4th, 6th, 8th, 10th, 12th thoracic, and the 2nd and 4th lumbar vertebrae, and on the prominence of the first piece of the sacrum. The measuring is done by slipping the picture under a transparent triple scale and reading off the units as shown on the scale.

In a thesis written by Miss MacEwan at Wellesley College, several measurements of spinal curves were tried. Maximum deviations from the "back line" joining the base of the pointers on the seventh cervical vertebra and the sacrum were found to be most satisfactory for their purposes from a statistical, as well as a practical, point of view. Lines were also drawn from the seventh cervical and sacral points to the point of change of flexure. The deviations from these lines (the broken line) gave a better measure of dorsal and lumbar curves as such. The variables and correlations of 243 subjects used for intensive study were as follows:[14]

1. Criterion posture grade (5 judges).

[13] C. G. MacEwan and E. C. Howe, "An Objective Method of Grading Posture," Research Quarterly, 3 (October 1932), pp. 144–157.

[14] By correspondence, Elizabeth Powell, Wellesley College.

2. Thoracic depth (from upper half of broken line).
3. Lumbar depth (from lower half of broken line).
4. Sum of dorsal and lumbar depths (from broken line).
5. Sum of curves (from single back line).

$r_{12} = .465$ $\quad r_{23} = -.044$ $\quad r_{15} = .583$

$r_{13} = .320$ $\quad r_{14} = .563$ $\quad r_{45} = .964$

Using the deviations from the "back line" and the "broken line," vernier caliper measurements were made on fifty Yale photographs with the following results:

1. Thoracic depth from "broken line" and thoracic depth from "back line."
   $r = .728 \pm .043$
2. "Kyphosis Angle" and thoracic depth from "back line."
   $r = .748 \pm .041$
3. "Kyphosis Angle" and thoracic depth from "broken line."
   $r = .781 \pm .036$
4. Lumbar depth from "broken line" and lumbar depth from "back line."
   $r = .725 \pm .043$
5. "Lordosis angle" and lumbar depth from "back line."
   $r = .802 \pm .034$
6. "Lordosis angle" and lumbar depth from "broken line."
   $r = .826 \pm .029$
7. Sum of dorsal and lumbar depths from "broken line," and sum of curves from single "back line."
   $r = .906 \pm .018$
8. Sum of "kyphosis and lordosis angles" and sum of curves from single "back line."
   $r = .857 \pm .026$
9. Sum of "kyphosis and lordosis angles" and sum of dorsal and lumbar depths from "broken line."
   $r = .927 \pm .013$

A Comparison of the Whole Method, the Minor Game Method, and the Whole Part Method of Teaching Basketball to Ninth-Grade Boys

By Thomas J. Cross
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NUMEROUS investigations have been made in the past in the field of psychology and education of the relative superiority of the whole and the part methods of acquiring knowledge of motor skills. The conclusions of the different investigators have not been in complete agreement, and the various factors which influence the results must be considered by the reader in each series of investigations.

Psychological investigations in the past have centered chiefly about the memorizing of nonsense syllables, and in the motor field have been chiefly concerned with the tracing of mazes, or with piano playing and typewriting skills. On the basis of these investigations and their results, we can extend experimental work into the realm of practical learning problems in other areas of learning, all the while considering the individual variations and general and specific factors which alter the conditions of learning.

METHODS AND SOURCE OF DATA

This experiment was carried on in the Junior High School, Jefferson City, Missouri, during the school year, 1932–33. At the beginning of the term the principal divided the ninth-grade physical education classes into three groups, each group meeting two times per week. Each group was assigned a method of learning: the first hour class, the whole method; the second hour class, the minor game method; the third hour class, the whole part method.

These groups were given basketball tests worked out by Edgren and by Brace, and some additional ones devised by the writer. These tests included the fundamental skills of basketball such as:

1. Accuracy throwing
2. Speed pass
3. Passing and handling ball
4. Speed dribble
5. Speed in bouncing ball
6. Skill in getting ball
7. Shooting baskets
8. Dribble and shoot
9. Pivot and shoot
10. Dribble and pass
11. Opposition shooting
12. Speed shooting
13. Getting ball and shooting
14. Speed of start and stop
15. Side shift foot work
16. Jump and reach
17. Bounce pass accuracy

These tests, which are too detailed to outline here in full, can be found in the author's thesis presented to the Graduate College, State University of Iowa.

The above tests were given each group at the start of the basketball season, November 14, 1932. The tests were carried on for a period of six weeks, until December 23, 1932. The tests were repeated starting January 2, 1933, and ending February 10, 1933, and the results noted in each method.

The procedure used in teaching the whole method was to give the group a basketball and let them play the game. In the second group the minor game method was used by playing games such as indoor baseball, dodgeball, volleyball, and relay games in the gymnasium classes. These games were used to build up certain fundamental skills which it was believed would be carried over into basketball. In the third group the whole-part method was used by dividing basketball into the fundamental skills. One fundamental skill was shooting, which included high arch shots, backboard shots, set-up shots under the basket, the shot-put shot, and shooting straight at the basket. Passing, another skill, was taught under this method by easy passing to accustom the boys to handling the ball, and by the two-handed underhand pass. The final skills taught by this method were body movement and footwork, consisting of starts, sudden stops, full pivots, turns, and changes of pace.

The statistical methods used in analyzing the scores made by the boys upon the various tests are too common and are too well founded to need explanation or justification here. The mean of the scores of the boys taught under one method is compared with the means of the scores of those taught under the other methods. A test of significance is made to see if the difference between the means is probably larger than that caused by the experimental error.

INTERPRETATION OF RESULTS

At this point it is important to point out that the tests themselves are made up of so many elements that a better picture of the results can be had if each test is broken down into its particular elements. This requires that the complexity of each element be taken into account as well as the number of elements making up the test. With this in view it is possible to weight each test, and to determine upon this basis the relative value of the methods. The necessity of the above described procedure is emphasized when we see that one method was not superior in all of the tests, or even in a great enough number of them to warrant any general conclusions.

Table I gives the mean scores made upon each of the seventeen tests for each group of boys, and the differences between these mean scores. The critical ratio is used to determine whether or not the differ-

ence between two sets of results is statistically significant. The formula for this is:

$$\text{Critical Ratio} = \frac{M_1 - M_2}{\sqrt{\frac{\sigma_1}{N_1} + \frac{\sigma_2}{N_2}}}$$

where M_1 is the mean of the first distribution, M_2 is the mean of the second distribution, σ_1 is the standard deviation of the first distribution, σ_2 is the standard deviation of the second distribution, N_1 is the number of cases in the first distribution, and N_2 is the number of cases in the second distribution. To be significant the critical ratio should be approximately 2.5 or more.

The following is a statement concerning the skills in which one method was statistically significantly better than one or both of the other methods. The component parts of each activity are listed and weighted as to difficulty or complexity.

TESTS IN WHICH WHOLE METHOD WAS BEST

Test I. Accuracy Throw.—

a) Visual and hand coordination of passing ball (complexity 3).[1]
b) Muscle coordination of passing ball (complexity 3).

Test II. Speed Pass.—

a) Visual and hand coordination of catching ball (complexity 3).
b) Muscle coordination of passing ball (complexity 3).
c) Muscle coordination of handling ball (complexity 3).
d) Change from catch to throw (complexity 3).

Test XIV. Speed of Start and Stop.—

a) Pivoting (complexity 5).
b) Muscular coordination of feet (complexity 5).
c) Ability to start and stop (complexity 5).

TESTS IN WHICH MINOR GAME METHOD WAS BEST

Test VII. Shooting Baskets.—

a) Visual and hand coordination of catching ball (complexity 3).
b) Muscular coordination of handling ball (complexity 3).
c) Skill in shooting (complexity 3).
d) Visual and hand coordination in shooting (complexity 4).
e) Change from catch to throw (complexity 3).
f) Muscular coordination of feet (complexity 3).

Test XV. Side Shift Footwork.—

a) Muscular coordination of feet (complexity 4).
b) Ability to start and stop (complexity 5).

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[1] The rating for complexity ranged from 1 to 5. The most complex were given a rating of 5. These ratings were subjective, based upon the beliefs of a number of experienced teachers.

Test XVI. Jump and Reach.—
a) Ability to jump (complexity 4).

TESTS IN WHICH WHOLE PART METHOD WAS BEST

Test VIII. Dribble and Shoot.—
a) Muscular coordination of handling ball (complexity 3).
b) Stop and grasp ball (complexity 3).
c) Skill in shooting (complexity 3).
d) Visual and hand coordination in shooting (complexity 3).

Test IX. Pivot and Shoot.—
a) Muscular coordination of handling ball (complexity 3).
b) Skill in shooting (complexity 3).
c) Visual and hand coordination in shooting (complexity 3).
d) Pivoting (complexity 5).
e) Muscular coordination of feet (complexity 3).

Test X. Dribble and Shoot.—
a) Muscular coordination of handling ball (complexity 3).
b) Stop and grasp ball (complexity 3).
c) Skill in shooting (complexity 3).
d) Visual and hand coordination in shooting (complexity 3).
e) Muscular coordination of dribble (complexity 3).
f) Muscular coordination of feet (complexity 3).

Test XI. Opposition Shooting.—
a) Muscular coordination of handling ball (complexity 3).
b) Stop and grasp ball (complexity 3).
c) Skill in shooting (complexity 3).
d) Visual and hand coordination in shooting (complexity 4).
e) Pivoting (complexity 3).
f) Muscular coordination of dribble (complexity 4).
g) Muscular coordination of feet (complexity 3).
h) Ability to start and stop (complexity 3).

Test XIII. Getting Ball and Shooting.—
a) Muscular coordination of handling ball (complexity 3).
b) Stop and grasp ball (complexity 3).
c) Skill in starting (complexity 3).
d) Visual and hand coordination in shooting (complexity 3).
e) Muscular coordination of feet (complexity 3).
f) Ability to start and stop (complexity 3).

The whole method was superior in tests 1, 2, and 14. The total complexity of these tests is 33; the average is 11. The tests which were taught best by this method were relatively simple tests, and might be considered to give somewhat the same results here as the whole part method because they involved very simple learning steps, such as accuracy throw, that could not be broken down into separate elements.

The minor game method was superior in tests 7, 15, and 16. The

TABLE I

Test		Means		
No.	Name	Whole Method	Minor Game Method	Whole Part Method
1	Accuracy Throw	56.93	54.36	49.32
2	Speed Pass	55.06	55.63	52.58
3	Passing and Handling Ball	54.03	58.63	57.93
4	Speed Dribble	52.13	51.63	50.96
5	Speed in Bouncing Ball...	52.62	56.40	54.45
6	Skill in Getting Ball	54.55	53.31	53.45
7	Shooting Baskets	50.82	53.95	50.83
8	Dribble and Shoot	54.17	50.90	54.61
9	Pivot and Shoot	52.34	48.81	53.70
10	Dribble and Shoot	51.79	51.68	53.87
11	Opposition Shooting	52.48	51.59	53.93
12	Speed Shooting	51.58	52.54	51.83
13	Getting Ball and Shooting	49.72	51.50	49.00
14	Speed of Start and Stop..	52.72	56.95	48.77
15	Side Shift Footwork	52.06	56.27	53.61
16	Jump and Reach	52.13	54.40	52.96
17	Bounce Pass Accuracy....	53.03	50.81	50.87

total complexity of these tests is 39; the average is 13. The tests which showed the best results by this method were those which involved co-ordinations of skills which were developed to a much more proficient stage through practice in minor games in a somewhat more simplified organization.

The whole part method was superior in tests 8, 9, 10, 11, and 13. The total complexity of these tests is 91; the average is 18.2. This method was superior in the largest number of tests, and the tests shown

TABLE II

Test		Differences		
No.	Name	Whole–Whole Part	Whole–Minor Game	Minor Game—Whole Part
1	Accuracy Throw	7.60	2.56	5.04
2	Speed Pass	2.48	— .56	3.05
3	Passing and Handling Ball	—3.90	—4.60	.70
4	Speed Dribble	1.17	.50	.66
5	Speed in Bouncing Ball...	—1.83	—3.78	1.95
6	Skill in Getting Ball	1.10	1.23	— .13
7	Shooting Baskets	— .01	—3.12	3.11
8	Dribble and Shoot	— .44	3.26	—3.70
9	Pivot and Shoot	—1.36	3.52	—4.80
10	Dribble and Shoot	—2.07	.11	—2.18
11	Opposition Shooting	—1.45	.89	—2.34
12	Speed Shooting	— .25	— .95	.70
13	Getting Ball and Shooting	.72	—1.77	2.50
14	Speed of Start and Stop..	—3.94	—4.23	8.18
15	Side Shift Footwork	—1.54	—4.20	2.65
16	Jump and Reach	— .82	—2.27	1.44
17	Bounce Pass Accuracy....	2.16	2.21	— .05

best by this method were ones which could be broken down into simpler parts. This made it possible to master the skills to a higher degree of proficiency than in any other method. The skills best taught by the whole-part method involved a greater complexity of muscle coordination and intellectual concepts than the tests best taught by the other methods. Probably the practice of the parts proved most valuable as much because of the simplifying of the intellectual concepts, as because of the simplifying of the motor coordination.

TABLE III

Test		Critical Ratio		
No.	Name	Whole–Whole Part	Whole–Minor Game	Minor Game–Whole Part
1	Accuracy Throw	1.89	1.57	1.75
2	Speed Pass	.8935	1.23	1.13
3	Passing and Handling Ball	1.81	1.83	2.04
4	Speed Dribble	1.30	1.79	1.79
5	Speed in Bouncing Ball...	2.59	3.47	3.73
6	Skill in Getting Ball	1.77	1.69	1.10
7	Shooting Baskets	2.15	2.44	3.06
8	Dribble and Shoot	1.08	1.08	1.14
9	Pivot and Shoot	.86	1.08	1.05
10	Dribble and Shoot	.92	.71	.88
11	Opposition Shooting	.95	.86	.92
12	Speed Shooting	1.13	1.00	1.14
13	Getting Ball and Shooting	1.06	1.20	1.03
14	Speed of Start and Stop..	1.16	2.34	2.22
15	Side Shift Footwork	1.58	1.56	1.68
16	Jump and Reach	1.57	1.61	1.44
17	Bounce Pass Accuracy....	1.69	1.62	1.36

While this study is in no way an exhaustion of the field, a few conclusions can be pointed out.

1. The simpler unitary skills (visual and hand coordination of catching ball, muscle coordination of passing ball, and changing from catch to throw) are best taught by the whole method.

2. The most complex skills and those that are intellectually complex as well as complex from a motor point of view (muscular coordination of handling ball, stopping and grasping ball, skill in shooting, visual and hand coordination of dribble, muscular coordination of feet, and ability to start and stop) are best taught by the whole-part method.

3. Skills of intermediate degree of complexity and ones which are easily carried over from simpler games in identical form (such as pivoting, change from catch to throw, ability to start and stop, and ability to jump) are best taught by the minor game method.

The Administration of School Playgrounds in the Educational System of Chicago

By Wilton S. Clements
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WELL directed play is believed by many to strike at the roots of all child evils. The value of the school playground as a medium of wholesale recreation, as a method of reducing child delinquency, as a deterrent to juvenile accidents, and as a builder of good citizenship is accepted today by the majority of the American public.

It is claimed that supervised play on school playgrounds makes for health, raises the moral standard, develops leadership and fair play; it is believed to create a proper sense of responsibility and respect for authority; it creates a credence that childhood happiness, general welfare, and good citizenship are natural results of supervised school playgrounds.

Is the foregoing true? The purpose of this dissertation was to attempt to learn if there were worth-while relations and educational values to be found in the school playground program.

The Chicago school playground system was selected for study because it was one of the earliest established in this country. It has long been acknowledged as outstanding in the administration of after-school recreation on small plots of ground adjacent to the school building. This is accomplished through a special department of the board of education known as the Bureau of Recreation. Furthermore, the investigator has been a member of this department as instructor in charge of one of the sixty-one recreation centers, operated day and night throughout the year, for more than ten years.

MECHANICS OF STUDY

No studies of the Chicago school playgrounds were available from which to draw data for comparative purposes. The material for this study was taken from primary sources such as official records, rules, and regulations of the Bureau of Recreation of the Chicago school system and of the municipal playground system of Chicago, interviews with members of the staff of the foregoing systems, and excerpts from personal notes collected by the investigator during the past ten years as instructor in the school playground system.

A resume of a dissertation submitted to the faculty of the Division of the Social Sciences in candidacy for the degree of Master of Arts, Department of Education, University of Chicago.

A description of the organization and administration of the Chicago school playground system, in comparison with the municipal playground system, was made from the point of view of the school playground system's relation to the general program of public education in Chicago.

The seven general objectives of education—widely known as the "Seven Cardinal Principles of Secondary Education,"[1] the four objectives claimed by the North Central Association[2] and the six objectives of the Chicago elementary schools[3] were used to test the data on school playgrounds.

The key words to the foregoing statements in their final analysis are:

(1) Social Relationships	(4) Worth-while Activity
(2) Self-Expression	(5) Knowledges and Skills
(3) Critical Thinking	(6) Health

RESULTS OF THE FINDINGS

As a result of the description of the organization and administration of these sixty-one playgrounds in the public school system and thirty-three playgrounds of the municipal system of the city of Chicago, in relation to the educational program of the public schools of Chicago, the study shows that while the school playgrounds were once a part of the municipal system, they are now distinctly a part of the educational system of the Chicago public schools.

It was found that the supervised school playgrounds provide a great variety of recreational activities for children, and in many instances for adults as well. It was noted that cost for this service was surprisingly small, being actually eight cents per capita for those using the facilities during the year 1935.

The study gives evidence to believe that while a strong similarity existed between the municipal playground system and the Bureau of Recreation, the latter program provided a greater variety of activities by actual count and had more than two million more in attendance during the year of 1935 than the municipal playgrounds.

In relation to the objectives of education, the supervised school playground appears to provide an unusual opportunity in social relationships because the program is "dynamic and moving." Too, racial differences, selfish habits, and undesirable ambitions are usually forgotten in the intense interest of the activity at hand.

To a certain extent, the child on the supervised school playground

[1] *Cardinal Principles of Secondary Education*, A Report on the Reorganization of Secondary Education, Appointed by the National Education Association, pp. 10–11. Department of Interior, Bureau of Education Bulletin No. 35. (Washington: Government Printing Office, 1918).

[2] Milo H. Stuart and D. H. Eikenberry, "Secondary Education in Chicago," *Report of the Survey of the Schools of Chicago, Illinois*, Vol. II. (New York: Teachers College, Columbia University, 1932), p. 1621.

[3] Jesse H. Newton, *et al.*, "The Curricula of the Schools," *Report of the Survey of the Schools of Chicago, Illinois*, Vol. III, p. 18.

learns to practice desirable social relationships through something of a "dramatized pedagogy," for actual life conditions occur with greater frequency on the playground than in the classroom. The children then learn to live harmoniously together by playing harmoniously together.

The educational aims of desirable social relationships are shown to be aided by the program of the supervised school playground, for it provides interesting activities during the late afternoon and early evening to the adolescent boy and girl, and in many instances, to adults as well. Promiscuous petting, vulgar story-telling, and other questionable practices are counteracted by vigorous, interesting, athletic activities in which, in most cases, the sexes are separated. Of course, there are times when mixed groups participate in a social-athletic form of recreation under the direction of either the man or woman instructor.

Self-expression, the second of the educational aims, is encouraged in the children by discovering and nurturing their desirable aptitudes. The great variety of activities offered in the playground program, the interest shown by the instructor, and the ease of participation, enable each child to test himself to find his greatest interest and ability. It is free at the school playground, the child may come and go as he chooses, and he may participate in some activity for a few minutes or several hours.

Critical thinking was found to play an important role in the life of every child on these supervised school playgrounds, for, in contrast to the school room indoctrination, the child on the playground is both permitted and encouraged to think and decide things for himself. Compulsory attendance of the classroom is replaced by stimulating activities out-of-doors.

Experienced recreation workers know children are not prone to express opinions if they do not like the program or the instructors. Where freedom of thought and encouragement of critical thinking, as found on the Chicago school playground, is a common thing, then the fact of attendance and participation figures illustrate the high opinion of the children toward the supervised school playgrounds in the Chicago school system.

Worth-while activities are the basic enterprises of the supervised school playground. They permit democratic participation and involve standards that are in keeping with the psychological, moral, and ethical limitations of the group at hand as accepted and approved by the majority of our recreation leaders today.

The facts shown in this study of how the annual Halloween celebration on each supervised school playground has decreased vandalism in the immediate neighborhood of the school are indicative that playground activities in Chicago are worth while.

On Halloween night, during the period of 1934, 1935 and 1936, the Chicago Police Department recorded all complaints of vandalism and other juvenile disturbances over the entire city and found that the

greatest number of calls came between the hours of 7:00 to 10:00 P.M. All calls were distributed in the following manner:

TABLE I

DISTRIBUTION OF COMPLAINTS TELEPHONED TO THE CHICAGO POLICE DEPARTMENT ON HALLOWEEN NIGHT FOR THE YEARS 1934–1936

Time of Day	1934	1935	1936
Between 7:00–10:00 P.M.	264	192	157
Before 7:00 P.M. and after 10:00 P.M.	82	167	105

From the foregoing figures on all complaints by telephone to the police department, it was found that in thirty-eight communities served by school playgrounds (the Director estimates an area around each playground of one-half mile radius) there were no complaints registered. In the areas served by the remaining twenty-two school playgrounds there were only forty-six complaints made to the police department. This gives an average of two plus for twenty-two communities having school playgrounds. It is to be remembered each of the school playgrounds conducts a well organized Halloween party from 7:00 to 10:00 P.M.

For the past two years, an accurate check has been made on the objective results of the school playground program on Halloween night. The number of complaints made to the police department—via stations nearest to school playgrounds—have been compared with the number of complaints from those communities without school playgrounds and the records show that the number of complaints from the latter area have been in excess, *about five to one*, of those from the school playground communities.

Proper knowledges and skills, as well as many concomitant learnings, were shown to be the natural results of the supervised school playground program. Technically trained instructors on the school playgrounds (each man and woman must hold a teacher's certificate in the Chicago public school system) and a highly organized, scientifically tested program make the foregoing educational aim a fact.

Attendance records each year show large numbers participating in the school playground activities that tend to prepare the individual for further like participation and enjoyment even in late adult life.

The total attendance of 8,167,469 people for the year of 1935 was estimated in the following proportions: boys 51 per cent, girls 34 per cent, men 11 per cent, women 4 per cent. While the majority of the attendance is expected to be made up of boys and girls, it is important to note that 15 per cent of more than eight million people in attendance were of adult age. This is important in the light of two facts related to Chicago's recreational facilities. The first is the elaborate setup, vast facilities, and broad program of the Chicago Park System. The second, Chicago's numerous commercialized recreational enterprises.

Two reasons have been advanced for the unusually large adult

attendance on the school playgrounds. First, the fact that a great many of these people are natives of the city and as a result have grown up on or near a supervised school playground and are therefore acquainted with the advantages of these recreational centers. Second is the fact of a carefully selected and well organized series of activities that appeal to the adult public.

As a result of the foregoing, both children and adults are learning to take an active part in a wholesome form of recreation. The playground teachers are developing participants rather than spectators through the medium of a program that begins with the child and continues well into adult life. This statement is adequately borne out when one learns it is not uncommon to find two or even three generations participating in the activities on the supervised school playground.

Furthermore, it is interesting to note the number of mid-west champions in track, skating, wrestling, gymnastics, and numerous other sports who attest the fact of having received their start on the supervised school playgrounds. Brevity alone prevents naming dozens of these champion athletes, some of whom participated recently in the 1936 Olympics.

It was noted in the health education program of the supervised school playgrounds that three aspects were emphasized, namely, preventive, hygienic, and first-aid measures. Great care is used by the teachers in teaching the correct form and proper kind of participation in athletics as well as in the use of equipment. When accidents do sometimes occur, the playground teachers are well qualified to handle the situation in approved first-aid measures.

CONCLUSIONS

The facts found in the study of the administration of school playgrounds of the Chicago public education system show these small playgrounds to be an integral part of the public school system, maintained at a surprisingly low cost. Furthermore, they show that the accepted aims of the public elementary and secondary schools of Chicago are aided by the program of the Bureau of Recreation which provides a counteracting influence that tends to rehabilitate the vitality lost by the child as a result of the exigencies and restraints of school life.

The interest shown in the activities promoted on the supervised school playground as manifested by the attendance and participation of the general public indicates something of the importance of this form of recreation in the life of an urban people.

Studies in Testing Volleyball Skills

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FOR most of our sport activities numerous tests have been used, but with few exceptions without proof of reliability or validity. The writers have undertaken in the field of volleyball to (1) collect and assemble the previous work done in testing, (2) set up proposed tests, and (3) refine and change the test items according to accepted criteria.

A survey of volleyball skill tests discloses only one which shows statistical evidence of reliability or validity.[1] In this study, the authors give no evidence of the reliability of their tests, only of validity studies. Therefore, the instructor who uses available tests to grade and classify his pupils has no assurance that they are a true measure of the pupils' ability. They are, however, valuable to the person who is interested in experimentation with testing, and suggest a starting point for the formulation of volleyball skill tests.

The techniques required for playing volleyball can be classified into three general divisions. These are: "serving," "defense," and "attack" plays. Schroeder, Laveaga, Montgomery, French and Cooper, and Cubberley have analyzed volleyball skills. Miss Schroeder in her article "Fundamental Volleyball Skills," found in Spalding's *Athletic Handbook* for 1935–36 (pp. 103–111), has the same classification as that given above. In *Volleyball a Man's Game,* Mr. Laveaga has made four classifications as outlined by his chapter headings (pp. 51–108). These include "Handling and Setting up the Ball," "The Serve," "The Attack," and "Defensive and Offensive Plays." A study of Laveaga's content leads the writers to believe that the material included under "Handling and Setting Up the Ball" is included in his fourth classification on "Defensive Plays," and that, for this reason, three divisions would be sufficient. Similarly, Miss Montgomery in *Volleyball for Women* (p. 14) has made four classifications: "Service," "Defense" (receiving the ball sent by an opponent), "Passing the Ball" (to another member of the same team), and "Offense" (attacking by returning the ball to the opponents). From the description of the material included under "Defense" and "Passing the Ball," it was thought that this could be termed "Defense Play." French and Cooper studied the frequency with which certain types of play occur in women's volleyball and find serving (overhand and underhand), setup to self, volleying (under- and overhand),

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1 Esther French and Bernice Cooper, "Achievement Tests in Volleyball for High School Girls," Research Quarterly (May 1937) p. 150.

and recovery from the net most frequently used. In this grouping are serving, defense plays (setup and recovery from the net), and attack plays (volleying). Miss Cubberley, writing for the *Athletic Handbook* for 1935–36, has made five divisions of techniques: "Passing," "Recovery of Net Balls," "Setup," "Serving," and "Kill or Attack." The first three can be termed "Defense Plays."

The foregoing material shows that authorities are agreed on the two divisions of techniques, "serving" and "attack" play, and that there is least agreement on the classification of plays between team members. A summary of the volleyball tests now available follows. These tests have been arranged according to the three divisions first named: the "service"—putting the ball in play; the "defense play"—any play between team members including "receiving," "passing," "setting-up," and "playing the ball out of the net"; and the "attack"—the play which actually sends the ball across the net.

DISCUSSION OF TESTS ALREADY PUBLISHED

A detailed description of each test will not be given, but those interested in the field can find the material in the following sources. So that easy reference can be made to any specific test mentioned, a number corresponding to the source number will be placed after the test.

1. *A Volleyball Serving Test*, Illinois League of High School Girls Athletic Associations.

2. *Athletic Badge Tests for Girls*, Playground and Recreation Association of America, 1923.

3. French, Esther, and Bernice Cooper, "Achievement Tests in Volleyball for High School Girls," THE RESEARCH QUARTERLY, 8 (May, 1937).

4. Hartley, Grace, "Motivating the Physical Education Program for High School Girls," *The American Physical Education Review*, 34 (May, 1929).

5. Howland, Amy R., *National Physical Achievement Standards for Girls*, National Recreation Association, 1936.

6. Hupprich, Florence L., "Volleyball Tests," *The Athletic Handbook for Women*, 1928–29.

7. Laveaga, Robert E., *Volleyball a Man's Game*, A. S. Barnes and Company, 1933.

8. Reynolds, Herbert J., "Volleyball Tests," *Journal of Health and Physical Education*, 1 (March, 1930).

Serving Tests.—

The tests on serving, seventeen in number, range from a test which calls merely for the ball to be served across the net to a test for hitting a basketball hung from a chain above the net. In the majority of the tests the court is divided into areas and the test calls for definite placement of the ball—certain areas of placement scoring

higher than others. In general, balls landing in the back area of the court are given a higher score than those landing in the front part of the court. One of the tests (6) requires the server to hit a basket or chair placed in the three back positions. Another (6) attempts to test a player's ability to put an "in" or "out" curve on the ball. The number of trials is usually five or ten, the score depending on the area of the court in which the ball lands.

Three things are necessary for the execution of a good serve: getting the ball across the net, placing the ball, and putting speed or force into the serve. All of the tests on serving meet the first objective. The idea of placement is attempted in most of the tests, either by dividing the court into areas, or by having definite objects to hit. The speed or force of the ball is measured by scoring the back area of the court higher than the front.

Tests for the Defense Play.—

1. Setup Tests: A test of the setup should measure the ability to place the ball and to give it height. Two of the tests described measure only the ability to get the ball into the air (8). The other three (3 and 7) test the ability to place the ball as well as get height. Height is measured by comparison with the net or by ropes or frames hung over the playing field; placing is checked by divisions on the court or by a definite target.

2. Tests for Receiving and Passing the Ball: These tests should measure the ability of players to take the speed off the ball, and to place the ball. In two of the tests described (7) these abilities are measured—the ball is received from the service by a player, standing in the back part of the court, who attempts to pass the ball to some designated area on the same side of the net. In the other test (7), classed as a "controlled" test, placement is the main objective. The object of the test is to pass the ball, received from overhead in the rear part of the court, over a string ten feet high, to the front part of the court. Points are scored according to the section of the court in which the ball lands.

3. Tests for Playing the Ball Out of the Net: Playing the ball out of the net involves speed of reaction, the ability to play a low ball up and back, and placement. One of the tests (8) described measures the player's ability to get under the ball and play it up and back over a crossbar set up five feet above the floor and twelve feet from the net. Another test (6) measures the player's ability to get the ball out of the net and to send it to a definite area of the court. The third (3) requires that the ball be sent over a rope six feet high. Speed of reaction is involved in the ability to meet and place the ball coming out of the net.

Tests for the Attack Play.—

1. Receiving and Returning the Ball Across the Net: Placement of

the ball and power behind the placement are the main abilities involved in returning the ball. In four (6) of the eight tests described, the ball is received from a player on the opposite side of the net who tosses it to the one being tested. The receiver, standing in various sections of the court, attempts to return the ball across the net with an overhand or underhand pass so that it will land in certain areas marked out on the court. In two of the tests (8) the player, standing somewhere inside the court, tosses the ball up to herself and attempts to send it across the net to a definite area. In one test (7) the tosser is on the same side of the net as the player being tested. All of the tests attempt to measure placement of the ball, and two attempt to measure speed. One (7) does this by scoring the front part of the court higher for "attacking with speed," and the other (3) by repeated volleys for time against the wall.

2. Killing the Ball: There is only one test described on killing the ball. In this test (6) the receiver stands close to the net and the tosser to one side. Only balls which are close to the net and high are considered good tosses. The receiver kills the ball down over the net into the designated areas in the opponent's court. The element of killing the ball combines placement, speed, and the ability of the player to get up off the floor and over the top of the ball. The test described stresses placement and includes the other two in "killing the ball straight down over the net."

Summary.—

Inspection of the material on volleyball skill tests reveals that the number of serving tests outnumbers the tests of the other elements of the game. Either serving is thought to be the most important element of the game, or serving tests can be administered more easily than the other tests. There are seventeen serving tests; eleven tests of the defensive play of which three are for playing the ball out of the net, three for receiving and passing the ball, and five for setting up the ball; nine tests for the attack play of which one test is for "killing" the ball, one for repeated volleys against the wall, and seven for playing the ball across the net.

In general it can be said that the serving tests are objective. Because the test elements are constant, a certain reliability might be expected in the serving tests if a sufficient number of trials are given. In the other tests, for the most part, another player is involved in addition to the one taking the test. This second player is used to send the ball to the person taking the test. No uniform speed or height can be depended upon on receipt of the ball by the person taking the test, and for this reason possibilities of reliability would not be great. In the two controlled tests, described by Laveaga, reliability, as far as constant factors are concerned, is present because the ball comes from a constant height with a constant speed.

THE WISCONSIN VOLLEYBALL SKILL TESTS

The two tests, a serving and a volleying test, herein described, have in modified forms, been experimented with at the University of Wisconsin for several years.

The serving test meets the objectives set forth above. It measures (1) the ability to get the ball across the net, (2) placement of the ball, and (3) force of the serve (by the inclusion of the wire stretched above the net, as well as by the placement of the target on the court).

The volleying test combines several elements of the game: (1) timing of reaction, (2) receiving, (3) passing, and (4) accuracy of placement. Setting up to self is also used in the test if necessary for control of the ball.

The Serving Test.—

Equipment:

1. Standard volleyball.
2. Volleyball court—60′ x 30′.
3. Volleyball net—7′6″ above the floor at the center.
4. A radio wire bound with white adhesive tape at 5-foot intervals.
5. A target consisting of four frames; 16-, 12-, 8-, and 4-foot concentric squares.
6. Strips of heavy wrapping paper to be placed in two of the squares.

Note: The target consists of four square frames. Each frame is made up of four pieces of lumber (1¾″ high by ¾″ wide), hinged at the corners. The hinging makes it possible to fold up the target and push it out of the way when not in use. The four frames are held in place by two flat three-ply boards, one quarter inch wide, placed at right angles to each other, to which blocks of wood are nailed at the points where the frames fall.

Setup of Equipment: The strips of heavy wrapping paper, placed in the four-foot and twelve-foot frames help to verify in which frame the balls land because of the different sound made when the ball hits. The target is placed on the court so that the eight-foot frame falls directly over the corner of the court, thus putting the four-foot and eight-foot areas entirely in the court.

The radio wire is stretched 3′6″ above the top of the net.

The Test: The target is set up on the right side of the court. The subject stands behind the right one-third of the base line, on the opposite side of the court, and serves fifteen balls in succession. The target is then moved to the left side of the court and fifteen more balls are served. If the test is being given to a number of people at the same time, the target need be moved only once during the test. No person should serve more than fifteen balls in succession.

Scoring: 1. A ball which strikes inside the 4-foot square or frame bounding it, 7 points.

2. A ball which lands in the 8-foot square or frame bounding it, 6 points.

3. A ball which lands in the 12-foot square or frame bounding it, 5 points.

4. A ball which lands in the 16-foot square or frame bounding it, 4 points.

5. A ball which goes over the net and strikes in-bounds but not on the target, 2 points.

6. A ball which goes over the net and lands out-of-bounds, 1 point.

7. A ball which does not go over the net, 0 points.

Note: Balls which go over the net and under the wire stretched above the net, score one additional point.

Assistants: There should be at least four assistants for the serving test: a recorder who stands in a position to see all the balls that hit the target (opposite the center of the target on the side of the court on which it is placed), and who records them in the proper space on the score sheet; an assistant to the recorder who is at the net in such a position that she can see the balls which go over and under the wire and who calls out "over" or "under" to the recorder; two ball chasers whose duty it is to collect the balls and see that the server always has one on hand.

Score Sheet Instructions: The score sheet for recording the serves has two diagrams of four concentric squares representing the target. On one is recorded the serves to the right and on the other the serves to the left. Serve number 1 is recorded as 1 on the section of the target in which it lands, serve number 2 on the sections in which it lands, etc. Serves which do not land on the target are recorded in one of three spaces provided at the top of the sheet. These spaces are labeled:

(1) Error (a ball which did not go over the net).

(2) Over the net and in-bounds; but not on the target.

(3) Over the net and out-of-bounds.

If four-foot and twelve-foot frames are colored on the score sheet, it aids in the recording of serves and in the calculation of scores.

The score for each target is the total score for the four sections plus the score for those balls which go over the net but do not land on the target. The total serving score is the sum of the scores of the two sides.

The Volleying Test.—

Equipment:

1. Standard volleyball.

2. Stop watch.

3. Free wall space of indefinite height (at least 15 feet high and 12 feet wide).

Test Setup: Seven feet six inches above the floor and parallel with it, a piece of tin two inches wide is attached, with its lower level at the specified height. A line is drawn on the floor six feet from the wall.

The Test: The subject stands behind the six-foot line and tosses the ball into the air, and, using one or both hands, volleys it against the wall. Once the ball has left the hands she pays no attention to the six-foot line on the floor. The ball is volleyed as many times as possible in thirty seconds' time. If the ball is missed or goes beyond reach another ball is immediately handed to the subject and, with as little loss of time as possible, she starts it again behind the six-foot line. Only those balls are scored which hit on or above the tin strip; holding the ball is a foul and should be penalized immediately by making the subject step back to the six-foot line and start a new ball. Volleying the ball into the air does not count as a hit.

Scoring: Count the number of hits on or above the net line and deduct one for each new ball used. Three trials are given on each test. The girl is given time to rest between trials.

Assistants: The assistants needed on the volleying test are: a timekeeper; a girl to hand out additional balls who keeps track also of the number of balls used by the subject during her thirty seconds' trial, reporting these to the recorder after each trial; two recorders (one as a check on the other), who keep track of the balls which hit on or above the net line, and who call holding; one or two ball chasers who see that the second assistant always has a ball ready for the subject.

Score Sheet Instructions: Record the number of hits in one column, the number of balls used in a second column, and in a third column the score of each trial which is the number of hits minus the number of balls used.

Note: For convenience in keeping an individual's record on both tests together, the score sheet can be made out with the serving on one side and the volleying on the other.

RELIABILITY STUDIES ON THE SERVING AND VOLLEYING TESTS

Problem I.—

Purpose: To test the reliability of the serving and volleying tests as described above.

Procedure: The two tests were given during the volleyball season to 56 Wisconsin and 43 Idaho women registered in college classes, and to 20 sophomore majors at Wisconsin. The tests were given near the end of the season, which in both schools was approximately of the same length. The subjects took each test twice. The tests were taken not more than one week apart so that practically the same degree of achievement could be expected on both tests. The Pearson product-moment method of determining the coefficient of correlation was used.

Results: 1. When the scores of the first serving test were correlated with the scores made the second time the test was taken, the coefficient of correlation was .8313 with a P.E. of .01889.

2. The best scores of the three trials on the first volleying test, correlated with the best score on the second test, resulted in an *r* of .8446 with a P.E. of .0172.

3. Correlating the sum of the three trials on each of the volleying tests resulted in an *r* of .8915 with a P.E. or .01264.

Conclusions: 1. The serving and volleying tests as administered have an acceptable reliability. Garrett in *Statistics in Psychology and Education* states: "To be a reliable measure of capacity a mental or physical test should—generally speaking—have a minimum reliability coefficient of at least .80."[2]

2. Either method of scoring on the volleying test has a satisfactory reliability. In succeeding studies, the sum of the three trials, which has the higher reliability, will be used.

Problem II.—

Purpose: To determine whether the serving test can be shortened.

Procedure: The reliability of a shorter test in serving—less than 30 trials—was determined by using the results of the longer test. The scores for a portion of the test given the first time were correlated with the scores for the same portion of the test given the second time.

Results: 1. Correlating the first ten serves to each side (total of twenty) on the first test with the same on the second test, resulted in an *r* of .7712 with a P.E. of .02485.

2. When the first five serves to each side were correlated with the same on the second test an *r* of .6278 with a P.E. of .03715 was obtained.

3. The correlation of 15 serves to the target placed on the right side (right or left side of the court is determined by the position of the player facing the net on his own side of the court) of the court on the first and second tests resulted in an *r* of .7922 with a P.E. of .02258.

Conclusions: 1. Fifteen trials to one side of the court gives a barely acceptable reliability.

2. The reliability of the serving test cannot be maintained when the number of serves to either side is ten or lower.

Problem III.—

Purpose: To determine the effect on the reliability of the test of eliminating the wire.

Procedure and Results: The serving scores were calculated with the wire eliminated and the resulting coefficient of correlation between the first and second tests was .8363 with a P.E. of .01843.

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[2] Henry E. Garrett, *Statistics in Psychology and Education,* New York: Longmans, Green, 1926) p. 269.

Conclusion: The reliability of the test is slightly increased by the elimination of the wire.

VALIDITY STUDIES ON THE SERVING AND VOLLEYING TESTS

Problem I.—

Purpose: To determine the validity of the volleying test (sum of three trials) and the forms of the serving test which had a satisfactory reliability.

Procedure: In order to have some criterion with which to check the validity of the tests, each instructor (one at Idaho and two at Wisconsin) rated the players subjectively on their playing ability as "excellent," "good," "fair," or "poor." In the validity studies the major students were eliminated because the standard of ability for a major student would most likely differ from the standard set for a "college class" student. An individual rated as "fair" in the major group, when put into a college class might easily be rated as "good."

A comparison of the records of the Idaho and Wisconsin college students revealed the fact that the serving scores were consistently higher at Wisconsin than at Idaho and the volleying scores were higher at Idaho than at Wisconsin. At Wisconsin, the serving target could not be placed in the described position. Limitation of floor space in the gymnasium made it necessary to move the target nearer the net so that the twelve-foot square coincided with the court lines. The shorter distance between the center of the target and the subject may account for the higher serving scores at Wisconsin. A study of the conditions in the volleying test in the two universities suggests that the resilience of the walls used may account for the difference in scores. The Wisconsin wall was a hard plaster and unusually firm; the Idaho wall was a pliable wood with less resistance. The balls at Wisconsin might, therefore, rebound with greater speed and be more difficult to play.

In order to combine the data of the two groups in the succeeding calculations, all raw scores were tabulated, classified, and recorded in terms of distance from the mean in standard deviation units. The Wisconsin serving scores had a mean of 94.35 and a standard deviation of 28.64, while the Idaho mean was 78.18 with a standard deviation of 26.86; and the Wisconsin mean for volleying was 63.39 with a standard deviation of 20.24, while Idaho's mean for volleying was 109.65 and the sigma 35.5. All scores falling within one-half standard deviation above each mean were scored as 7 and each succeeding one-half standard deviation above was scored 8, 9, 10, etc. The scores below the mean were scored according to half standard deviations: 6, 5, 4, etc. For example, in the serving test a score of 7 was given to all Wisconsin scores between 94.35 and 108.66 and to all Idaho scores between 78.18 and

91.62. Wisconsin scores from 80.03 to 94.349 and Idaho scores from 64.76 to 78.179 were given a score of 6, etc.

Note: The second serving and volleying tests were used in the validity studies.

Results: 1. When the scores of the serving test were correlated with the subjective rating of the players, the resulting r was .7920 with a P.E. of .037.

2. The volleying scores correlated with subjective rating resulted in an r of .5130 with a P.E. of .04996.

3. The serving scores (calculated without considering the wire) correlated with subjective rating resulted in an r of .7807 with a P.E. of .02647.

4. The serving scores to one side of the court, found barely acceptable in reliability in the preceding study, when correlated with subjective rating, resulted in an r of .6850 with a P.E. of .03590.

Conclusions: 1. The serving test if given on one side of the court is not as valid a measure of volleyball ability as a test in which the target is placed first on one side and then on the other side of the court.

2. Eliminating the wire from the serving test has little effect on the validity. The difference in validity does not warrant the increased difficulty of administration when the wire is included.

3. Both the serving and the volleying tests have a high degree of validity. The serving test alone has a validity which makes it acceptable as a test for the ability to play volleyball. The volleying test would be valuable as an element combined with other tests measuring elements not included in the volley test.

Problem II.—

Purpose: To determine the validity of a volleyball test combining the serving and volleying test elements which have a satisfactory reliability and validity (serving validity .7920; volleying validity .5130).

Procedure: The multiple correlation of the combined tests with the criterion for ability to play volleyball (subjective rating of the instructor) was calculated, using the three variables: subjective rating, volleying, and serving.

Results and Discussions: 1. The correlation coefficient between volleying and serving scores is .5758 and indicates that: (1) with so high a relationship between these two factors, one of the tests would add little to the classifications made by the other, and (2) that students who rank high in one test tend to rank high in the other.

2. Partial correlations showed that if serving is held constant, the correlation between volleying and the subjective rating was .1144, and if volleying were held constant the serving score correlation with the subjective rating was .7076.

3. These correlations indicate:

a) That the subjective rating may be influenced largely by the subject's serving ability. Since there is opportunity to see individual play and its results, it would be logical to expect that the subjective rating would be largely dependent on the serving ability of the players.

b) That the skills—other than those measured in the serving test—which are needed to perform the volleying test successfully have only a slight relationship with the skills needed for successful volleyball playing.

c) That players ranking high in the skills measured in the volleying test would also rank high in the serving test.

d) A multiple correlation between subjective rating and the combination of serving and volleying, resulting in $R_{1.23}$ of .7950, substantiates the previous statement.

Conclusions: 1. The validity of the combined volleying and serving tests is the same as that of the serving test alone.

2. To score a subject on the volleying test does not increase the successful rating of his playing ability beyond the prediction made by his score on the serving test.

Problem III.—

Thinking that height might be a factor in the validity, both of serving and volleying, the heights of all the subjects were obtained, and further studies made on the tests.

Purpose: To determine whether a consideration of height is a factor in the validity of either the volleying or serving tests.

Procedure: The procedure was the same as that outlined in the preceding problem. Partial and multiple correlations were carried out first with the variables (1) subjective rating, (2) serving, and (3) height; and with the variables (1) subjective rating, (2) volleying, and (3) height.

Results and Discussion: 1. (Serving, height, and subjective rating). The zero order relation between serving and height resulting in an r of .3271 with a P.E. of .06180, showed some relation between these factors. A similar correlation between height and the subjective rating of .2631 with a P.E. of .0644 again indicated a slight relationship. Partial correlations showed that if height were held constant the correlation between serving and the subjective rating ($r_{13.2}$) is .7728 with P.E. .02358. A multiple correlation showing the combined effect of serving and height on the subjective rating gave an $R_{1.23}$ of 7906.

2. (Volleying, height, and the subjective rating). A simple correlation between volleying and height resulted in an r of .3648 showed about the same relationship as height with serving. A partial correlation between subjective rating and volleying holding height constant resulted in an $r_{13.2}$ of .4641 with P.E. .09517. The multiple correlation combining height and volleying resulted in $R_{1.23}$ of .5194.

Conclusion: The validities of neither the serving nor volleying scores are increased by including height as a factor.

GENERAL CONCLUSIONS

The following conclusions can be drawn from the studies made on the serving and volleying tests:

1. The two tests, as drawn up at the University of Wisconsin, are reliable and valid.
2. For purposes of predicting a player's ability in the game of volleyball, the serving test alone is sufficient.
3. The serving test cannot be cut in length.
4. The wire used in the setup of the serving test can be eliminated without affecting the reliability and validity of the test.

DISCUSSION

In searching for a possible reason for the serving test alone being sufficient for the prediction of volleyball playing ability, it was thought that the instructor in the subjective grading of her class might be unconsciously influenced by her knowledge of their serving ability and rate them on it rather than on their general playing ability. A possible solution to this might be to give two grades—one on serving ability and the other on general playing ability. The latter, if possible, should be rated by a person who does not know the serving abilities of the players. Further work on the subjective grading of individuals should be done before it can be definitely said that the volleying test adds nothing to the rating of playing ability.

There are elements in the game other than serving, and further research should be done to find tests that will measure these elements. In the opinion of the writers, experimentation on a "setup" and "passing" test would be worth while. The two "controlled" tests by Laveaga,

TABLE I

Reliability of Correlations

	r	P.E.
A. Serving		
1. First test with second test	.8318	.01889
2. First five on each side (total of 10) on first test, with same on second test	.6278	.03715
3. First ten on each side (total of 20) on first test with the same on the second test	.7712	.02485
4. Fifteen balls served to the right court on the first test with the same on the second test	.7922	.02258
5. First test correlated with second test eliminating the wire	.8363	.01843
B. Volleying		
1. First test with second test (best of three trials)	.8448	.0172
2. First test with second test (total of three trials)	.8915	.01264

described in the first part of this paper, seem to offer good possibilities. They are objective, have possibilities of reliability, use practically the same equipment, and could be set up at little expense.

TABLE II

VALIDITY OF CORRELATIONS

	r	P.E.
Serving with subjective rating (15 balls to each side—total of 30)	.7920	.037
Serving (wire eliminated) with subjective rating	.7807	.02647
Volleying with subjective rating	.5130	.04996
Serving (15 balls to right side) with subjective rating	.6850	.03590
Volleying with subjective rating (holding serving constant)	.1144	
Serving with subjective rating (holding volleying constant)	.7076	
Subjective rating with the combination of serving and volleying	.7950	
Serving with subjective rating (holding height constant)	.7728	
Subjective rating with the combination of serving and height	.7906	
Volleying with subjective rating (holding height constant)	.4641	
Subjective rating with combination of volleying and height	.5194	

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Absence from School–Influenza, Physical Education

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THIS paper is composed of two studies made at different times, with the data combined in one article. The studies will be discussed in the order that they were made. The original study on influenza involved only boys and was started in March 1936.

ORIGINAL INFLUENZA STUDY

This study originated from a desire to see if daily showers and exercise were helping to cause the large number of absences from the gymnasium classes during the recent influenza epidemic. The problem was set up, and with the permission of the school principal, D. H. Holloway, a collection of data was made.

Two lists of 307 boys each were made from the program cards filed in the office. The first contained the names of all the boys who were in gymnasium classes. The second list was made up of boys who did not have gymnasium classes on their programs. These names were taken as they appeared alphabetically. In order to keep out any systematic error, the names of all boys who had been excused from physical education by a doctor's certificate were taken off the second list. (The school nurse has a file of "doctor's excuses" from physical education.)

Next, the total number of day's absences from school for a three weeks' period was recorded after each name. The period of the study included the school weeks from February 17 to March 6. This period included the week of the peak number of absences, and the weeks preceding and following the peak week.

Upon tabulating the material, it was found that the 307 boys who were taking daily gymnasium classes had a total of 474 days absent from school, and the 307 boys not taking gymnasium work had a total of 600 days absent during the same period of 15 days. The frequency of absence is shown in Table I.

Before discussing the data, the school organization should be explained. Westport Senior High School includes the sophomore, junior and senior years. Physical education or R.O.T.C. is required for one year of all boys, with work in both departments optional for the remaining two years. All boys in either R.O.T.C. or physical education are given a

A paper presented before the Research Section of the Central District Association Convention, April 1937, Denver.

medical examination at the beginning of the school year. The remaining boys in school have had the same examination at least once during the preceding two years. This school is not equipped with a swimming pool, and all the classes were held indoors during the period of this investigation. Each group is very similar and care was taken in the experimental setup to keep the two groups comparable. It was necessary to take the boys alphabetically from the "A's" into the "M's" in order to get 307 boys not taking physical education. The two lists compose roughly two-thirds of the male students registered, 976.2 being the average enrollment for the semester.

These data show that there were 126 fewer days of absences in the physical education group. This figure can be considered as a true picture of the situation in this one high school for the 15-day period of the study. By applying sampling error statistics to these figures, one finds that there are over 99 chances in 100 that the difference would be positively in favor of physical education in like groups of students under like conditions.

Upon examining the data in Table I, one notices a "sport" case who was absent for 15 days. This boy rightly belongs to the group not taking physical education, but for sake of argument drop him from the distribution, and the average daily absence becomes 1.912

TABLE I
ORIGINAL INFLUENZA STUDY DATA

No. of days abs.	Group not taking P.E. Frequency of abs.	Group not taking P.E. No. of pupil days lost	Group taking P.E. Frequency of abs.	Group taking P.E. No. of pupil days lost
0	126	0	142	0
1	41	41	45	45
2	39	78	44	88
3	29	87	31	93
4	31	124	17	68
5	18	90	9	45
6	7	42	9	54
7	5	35	5	35
8	6	48	2	16
9	2	18	1	9
10	0	0	1	10
11	2	22	1	11
12	0	0	0	0
13	0	0	0	0
14	0	0	0	0
15	1	15	0	0
Totals	307	600	307	474

Average daily absence	1.953	SD 2.388	1.544	SD 2.029
SD of average	.1363		.1157	
Difference in averages	.409	SD of difference .1811		

$$\frac{\text{Difference}}{\text{SD of diff.}} = \frac{.409}{.1181} = 2.26$$

days instead of 1.953 days. The difference of .368 days still has 99 chances out of 100 of being in favor of those boys who take daily physical education work.

The exclusion of this boy makes little statistical difference in the final results of the study. No attempt was made to determine why each boy was absent from school during this 15-day period. However, influenza was epidemic during this time and absences from school were abnormally high. The average weekly absence for the entire semester was 235.5 as compared to weekly absences of 468, 723, and 398 during the three weeks covered by this study. There was no reason to suspect any other influence for absence which would not tend to be the same in each group.

These data show rather clearly that the male students in Westport Senior High School have fewer chances of being absent from school if they are taking daily work in the gymnasium classes.

When the problem was started, the writer had doubts as to whether any real difference would be found. If a difference were found, he suspected that it might be in favor of those students not subjected to daily exercises and showers during this epidemic period. Many students, even though constantly counseled to dry themselves thoroughly after a shower, found it too troublesome to spend the time. The writer was happy to find that his suspicions were not justified in this case, and that physical education showed a better "health group," thus justifying one of our many theoretical claims.

SEMESTER STUDY

The second study was started in September 1936, and was designed to cover the absences of both boys and girls over the period of the entire second semester of the school year 1935–36. Separate lists of the students in attendance at the close of school in June 1936 were made. These lists were divided as follows: (1) all boys taking physical education, (2) all boys taking R.O.T.C., (3) all boys taking neither physical education nor R.O.T.C., (4) excluded from list 3, all boys excused from R.O.T.C. or physical education by doctor's certificate, (5) all girls taking physical education, (6) all girls not taking physical education, (7) excluded from list 6, all girls excused by doctor's certificate from physical education.

The number of absences of each student from school during the semester was found, and tabulations were made from the various lists and are summarized in Table II.

The entire R.O.T.C. group of boys, the entire girls' physical education group, and the first 391 girls of the girls "no gym" group, were also tabulated for their absences during the influenza period of Feb. 17 to March 6. This data was added to the original influenza study and is also shown in Table II.

TABLE II

SUMMARY OF DATA

Influenza Study—Three Weeks Period

	Boys			Girls	
	Gym	No Gym	R.O.T.C.	Gym	No Gym
No. of pupils	307	307	217	391	391
Total no. of days absent	474	600	319	651	692
Average absence	1.544	1.953	1.474	1.665	1.770

Semester Study—Twenty Weeks Period

	Boys				Girls		
	Gym	R.O.T.C.	Neither	Excused	Gym	No Gym	Excused
No. of pupils	331	217	374	6	391	496	24
Total no. of days absent	1559	958	1975	44	1773	2704	176
Average absence	4.709	4.414	5.281	7.333	4.535	5.452	7.333

DISCUSSION

R.O.T.C. and physical education classes may both be classed as exercise periods. The R.O.T.C. unit, as taught in Westport, drills in the open air as soon as the weather permits. Since their uniforms are much heavier than gym suits, it is possible for them to do more outside work than the classes in physical education.

In adding the R.O.T.C. data to the boys' influenza study, one notes that the R.O.T.C. average absence is 1.474 days as compared to the gym boys' average of 1.544 days. The difference of .07 is small and cannot be considered as significant due to the different dates of the study. The 307 boys in the "no gym" group include about 50 per cent R.O.T.C. boys.

The girls' division of the influenza study data was compiled at the same time. The first 391 girls in the "no gym" group were used in order to make direct comparison possible with the 391 girls in the gym classes. The difference is small, only .105 day, but is in favor of the girls *who take gym.*

The study covering the entire semester shows an apparent discrepancy in the number of boys (331) taking physical education when compared with the number of boys (307) in the influenza study. This is because of the transfer to the physical education daily classes of the basketball squad members who wish to earn credit in physical education. This transfer took place at the end of the influenza study.

In the original influenza study a statistical technique was used to show that a significant difference existed between the boys' "gym" and "no gym" groups. This method was not employed on the data gathered in the semester study. But one should note that comparisons between "exercise" and "no exercise" groups are possible six times—four times for the boys and twice for the girls. *The difference each time is in favor of the exercise group.*

In the semester study there were 24 girls excused from physical education, and 6 boys who were excused from R.O.T.C. and physical education by doctor's certification. These boys and girls showed the same average absence of 7.33 days. This average is considerably higher than any of the other groups, and would indicate that they were rightfully excluded from active exercise.

CONCLUSIONS

1. Boys in gymnasium classes were absent fewer days during the influenza epidemic than boys not in gymnasium classes.

2. Girls in gymnasium classes were absent fewer days during the influenza epidemic than girls not in gymnasium classes.

3. R.O.T.C. boys were absent slightly less than the boys in gymnasium classes during the influenza epidemic.

4. The semester study shows that both the gym and R.O.T.C. boys were absent fewer days than the remaining boys in school.

5. The girls taking physical education were absent fewer days than the girls not enrolled in gymnasium classes.

6. Both boys and girls excused from gymnasium by doctor's certificates, were absent a much greater number of days than students in the other groups.

7. Students taking a daily exercise period seemed to have "something" which enabled them to be present at school for more days during both the epidemic period and the semester. Could this "something" be better health?

Gain in Health Knowledge of Two Groups of Women Students Classified in Physical Education

A Study of One Group which Attended Health Discussion Groups and Read Assigned Readings as Compared to Students Who Did Not

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STUDENTS classified in required physical education in the Texas State College for Women were given the opportunity to improve their health knowledge by attending non-compulsory health discussion groups and by reading hygiene assignments for a period of two years.

ORGANIZATION OF THE HEALTH DISCUSSION GROUPS

One health discussion group was scheduled each hour during the day paralleling the schedule of the physical education classes. From one to four physical education classes were scheduled each hour. The girls reported to the health discussion group at the same hour their physical education classes were scheduled.

Attendance in the health discussion groups was not required. If for any reason such as a cold, sore throat, an accident, disturbance of alimentary tract, pain at menstruation, or any other reason the student felt physically unable to attend the regular physical education class, she could attend the health discussion class.

STUDENT DISCUSSION LEADERS, TRAINING AND SUPERVISION

The health discussion groups were conducted by student assistants majoring in physical education. The courses taken by the leaders in their major field and in biologic sciences that contributed to education in health knowledge were physiology, anatomy, personal hygiene, individual gymnastics, and principles of health education.

The writer of this article supervised the student assistants. Scheduled conferences were held once a week during the fall semester and once every two weeks during the spring semester. The student leaders read and reported on the *Approach Through Interests in the Teaching of Health* as reported by Oberteuffer.[1] Topics from the assigned reading

[1] Delbert Oberteuffer, *Personal Hygiene for College Students*, (New York: Bureau of Publications, Teachers College, Columbia University, 1930).

list were presented at the conference group by the student assistants. The methods and devices of presenting the topics were criticised. Charts, manikins, daily health surveys, mimeographed list of questions, supervised reading, and sets of exercises were used by the students in the discussion groups.

HEALTH TOPICS

Every student enrolled in required physical education classes was expected to read the assigned readings before the topic was discussed in the health discussion group. The physical education instructors made the announcements of topics, dates, and specific page references to their classes. Fourteen different health topics were covered in the two years program of health instruction. In Table V may be seen the topics used in the first and second year of the study.

MEASURING THE GAIN IN HEALTH KNOWLEDGE BETWEEN GROUPS AND IN ONE GROUP BETWEEN PRETEST AND TEST

Instruments of Measurement.—The first year that the assigned readings and discussion groups were carried on, a health knowledge test was given at the end of the year in May. Form I Section A, a multiple true and false test containing 124 items, and Form II Section A, a single true and false test containing 64 items, were given to 1,005 young women students. The combined forms consisted of 188 test items.

The second year that the assigned readings and health discussion groups were conducted, a pretest was given in September, and the same questions were repeated in May as a test. This test consisted of two forms: Form I Section B, a multiple true and false test of 124 items, and Form II Section B, a single true and false test containing 63 questions or statements. The total number of items was 187. The number of young women given the test in May was 814. The total number who took both the pretest and test was 660. The test scores were used for the correlation of health knowledge between the pretest and the test.

Brief History of Choice of Items Used in Tests.—The items of both tests were chosen from 921 questions selected from six hygiene texts. Originally 670 items were given to 748 young women. The items were divided into four sections. The examination was given on two succeeding days lasting one hour at a time. These young women did not have the opportunity to attend health discussion groups, nor were they assigned health readings. The following year another group of young women was given an opportunity to attend health discussion groups. Three different sections of the health knowledge tests were given to 974 young women.

The questions were chosen according to the difficulty of question and goodness of question as answered by the above two groups of girls. The difficulty or reliability of a question was calculated by finding the

percentage of right answers to each question. The validity or goodness of the question was found by getting the difference between the answers to each item as made by the best scores and the poorest scores. Too easy and too hard items as well as all bad questions and "dead timber" were eliminated. The "bad" questions were those that were answered correctly oftener by the students who made lowest scores on the tests. The "dead timber" were the questions which were answered correctly as often by the young women who made low scores as by the young women who made high scores.

By the above methods the items in the health knowledge tests were selected.

TABLE I

COMPARISON OF HEALTH KNOWLEDGE OF THREE GROUPS

	Number of Students	Total Possible Points in the Test	Mean Score	Mean Per Cent of Items on Test Answers	Per Cent Gained
Group I	358	257	165.9	64.55	
Group II	814	187	141.6	75.72	11.17
Group III	575	187	123.85	66.2	

Group I was scheduled in physical education before health discussion groups were conducted and before the assigning of hygiene readings; Group II had the opportunity of attending health discussion groups and reading assigned readings as conducted by the physical education department; Group III were freshmen who had not attended college classes, health discussion groups, or read assigned readings.

As may be seen in Table I, the young women in Group II who attended health discussion groups gained on the average of 11.17 per cent more health knowledge than those who did not attend health discussion groups. Group I was composed of a group of young women who were selected at random. The group was composed of freshmen, sophomores, juniors, and seniors—that is, their classification was comparable to that of the students in Group II. If attendance in biological sciences, home economics, etc., increased health knowledge, then both groups should be influenced in similar degree.

As to the influence of college courses on health knowledge, Group III in Table I was composed of 575 freshmen who had just entered college two weeks previous to taking the test. They had not attended any college classes or the health discussion groups nor read the assigned readings. The mean percentage of items answered right by the freshmen is probably due to the refinement of the questions, as discussed in this article, and not due to actual knowledge. The above data would seem to indicate that attendance in health discussion groups and the reading of assigned readings increased the percentage of health knowledge of students from 64.55 to 75.72 per cent.

GAIN IN HEALTH KNOWLEDGE BETWEEN PRETEST AND TEST OF TOTAL GROUP OF YOUNG WOMEN WHO WERE ASSIGNED HYGIENE READINGS AND ATTENDED HEALTH DISCUSSION GROUPS

Table II shows the means in the second year of experiment. The mean score on the pretest in health knowledge of the total group classified in required physical education was 129.75. The mean score on the test in May was 141.6, a gain of 11.85 points.

The reliability or significance of the actual difference between the means of the pretest and the test may be found by dividing the difference by the standard error of the difference. Garrett states "It is usually customary to take a $\frac{D}{S.D._{diff}}$ of 3 as indicative of complete reliability, since —3S.D. includes practically all the cases in the 'distribution of differences' below the mean . . . "[2] A quotient greater than 3 is to be taken as added reliability. As may be been in Table II the resultant quotient is 18.52, which is six times as large as necessary to be considered indicative of complete reliability.

TABLE II

GAIN IN HEALTH KNOWLEDGE BETWEEN PRETEST AND TEST

	Number of Students	Possible Points	Mean	S.D.	$S.D._m$	$S.D._{diff}$	$\frac{D}{S.D._{diff}}$
Pretest	977	187	129.75	14.3	.46		
Test	814	187	141.6	12.4	.46	.64	18.52

GAIN IN HEALTH KNOWLEDGE ACCORDING TO CLASSIFICATION

There was an increase in health knowledge with increase in classification as shown in Table III. The largest gain of 14.35 points in health knowledge was made by freshmen, the next largest gain of 12.95 points was made by juniors, a gain of 7.7 points was made by seniors, and the sophomores gained on the average of 7.15 points. The number of seniors who took the pretest and test was small in comparison to the freshmen and sophomore groups which may account for the smaller gain in health knowledge.

The large statistical significance between the means of the pretest and test for the freshmen, sophomores, and juniors is indicative of complete reliability. The chances are 99 in 100 that the true difference between the means of the pretest and test of the seniors is greater than zero.

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[2] Henry E. Garrett, *Statistics in Psychology and Education*, (New York: Longmans, Green and Co., 1926), p. 133.

TABLE III

GAIN IN HEALTH KNOWLEDGE BETWEEN PRETEST AND TEST AS MADE BY FRESHMEN, SOPHOMORES, JUNIORS, AND SENIORS

		Number of Students	Mean	Gain in Points	S.D.	$S.D._m$	$S.D._{diff}$	$\frac{D}{S.D._{diff}}$
Freshmen								
	Pretest	575	123.86		12.5	.52		
	Test	476	138.2	14.35	11.55	.53	.74	19.39
Sophomores								
	Pretest	323	137.5		12.1	.67		
	Test	254	144.65	7.15	11.	.69	.95	7.53
Juniors								
	Pretest	51	138.5		12.5	1.75		
	Test	55	151.45	12.95	11.75	1.58	2.35	5.51
Seniors								
	Pretest	28	144.1		10.75	2.03		
	Test	29	151.8	7.7	11.75	2.18	2.98	2.58

TABLE IV

THE ATTENDANCE OF YOUNG WOMEN IN HEALTH DISCUSSION GROUPS ACCORDING TO THE TYPE OF PHYSICAL EDUCATION AND REASONS FOR ATTENDING

	Swimming	Sports	Dancing	Individual gymnastics	Major classes	Total attendance	Grand total
Menstruation	1313	645	755	135	102	2950	
Colds	245	15	39	13	2	323	
Reasons: Sprains, burns, etc.	110	30	46	40	2	228	3501
Class periods from which there were no reports	40	120	103	65	37	365	

THE ATTENDANCE IN HEALTH DISCUSSION GROUPS

The total attendance in health discussion groups was 3501 which is an average attendance of 4.3 times for each of the 841 girls scheduled in physical education during the second year of the experiment.

DIFFICULTY OF TEST SECTIONS

The percentage of correct answers for each question or item on the three tests was calculated. Fifteen hundred papers or five hundred health knowledge tests from each of the three examinations were chosen at random. Table V shows the difficulty of the health topics according to correct answers for the final test of the first year, and the pretest and test of the second year.

TABLE V

DIFFICULTY OF HEALTH TOPICS ACCORDING TO THE ANSWERS OF 1500 YOUNG WOMEN

	First Year of Experiment		Second Year of Experiment			
	Test in May 500 Test Papers		Pretest 500 Test Papers		Test 500 Test Papers	
	Number of Questions Under Each Topic	Average Percentage of Correct Answers	Number of Questions Under Each Health Topic	Average Percentage of Correct Answers	Percentage of Correct Answers	Average Percentage Gain in Correct Answers Between Pretest and Test
Topic						
Bathing	17	72	17	70	74	4
Colds			22	73	81	8
Elimination	18	75				
Fatigue	19	85				
Care of feet	19	76				
Hygiene of eating			18	75	83	8
Food and diet			19	59	65	6
Ideals and attitudes	18	72	18	70	76	6
Infections	18	72				
Menstrual hygiene	16	80	16	69	80	11
Mental hygiene	16	73	16	73	79	6
Nutrition	18	72				
Posture	18	71	23	59	63	4
Sleep and rest			16	76	80	4
Underweight overweight	26	76	25	75	80	5

DIFFICULT TEST ITEMS

Seventy-six per cent of the young women believed that greater energy needs of the body may be most easily met by an increase in vitamins and proteins. Forty-four per cent answered the statement, overweight if more than slight may be due to endocrine origin, as false. Sixty-six per cent did not know that the bulky foods are contained in a reducing diet. The above answers would indicate that the young women need to know more concerning the hygiene of diets. Sixty-eight per cent answered that a cold shower should be used to "jazz up" a tired personality.

The statement, "Health should be an end within itself," was answered as true by sixty-one per cent of the young women. "The most

important directions for obtaining correct posture are *hold chin up, hold the shoulders up,* and *throw out the chest.*" These statements were answered as true by 63, 64, and 77 per cent of the young women.

SUMMARY

The health knowledge of young women who attended health discussion groups and read assigned readings improved 11.17 per cent over those who did not attend. The health knowledge of young women who attended college classes in biologic and general sciences and home economics classes, but who did not attend health discussion groups and read assigned readings, did not exceed the health knowledge of freshmen entering college.

The increases in the range of the mean scores of health knowledge between the pretest and test for freshmen, sophomores, and juniors were significant.

The most difficult topic or section was posture. The least percentage gain in knowledge was made under the topics entitled bathing, posture, sleep, rest, and underweight and overweight.

Fundamental test items were missed by a high per cent of the students taking tests.

HEALTH KNOWLEDGE TEST

Directions: About one-half of the following statements are true and about one-half are false. Mark each true statement with a plus sign (+) on the dotted line at the left of the statement. Mark each statement that is partly or wholly false with a zero (o) on the dotted line to the left of the statement.

Mark the statements in order:

Sample Exercises.—

I. The amount of responsibility which a teacher may assume in cases of abnormal conditions is:

..+.. 1. To draw attention to the school physician.
..+.. 2. To cooperate by giving advice.
..+.. 3. To place initial responsibility on parents.
..o.. 4. To take initial responsibility.

II. Some of the powers and limitations of the Federal Food and Drug Act are:

..o.. 1. It applies to products sold in the same state as that in which they are made.
..+.. 2. It does not prohibit false or misleading statements regarding curative effects elsewhere than in or on the trade package.
..+.. 3. It does not prohibit false or misleading statements in newspapers or advertisements.

III. It has been demonstrated that the "badness" of air in ordinary buildings is due to:

..o.. 1. Organic poison.
..o.. 2. Excessive amounts of carbon dioxide.
..+.. 3. Lack of air movement.
..+.. 4. Improper temperature.
..+.. 5. Improper humidity.

IDEALS AND ATTITUDES

I. For most people their health is defined by:
...... 1. Ideals and attitudes of the time.
...... 2. Scholastic philosophy.
...... 3. Academic methods.
...... 4. Influence of society itself.

II. Health is:
...... 5. A philosophy of life.
...... 6. A quality of life that renders the individual fit to live most and serve best.
...... 7. A sound physical body.
...... 8. A physical, mental, and social concept.

III. Health should be:
...... 9. A belief in pseudo-magic.
......10. An end in itself.
......11. One of the primary aims of education.
......12. An objective of the whole educational process.

POSTURE

IV. Inefficiency and weakness are established by:
......13. Appearing short when really tall.
......14. Flat chest.
......15. Prominent abdomen.
......16. Prominent shoulder blades.

V. Of the following the most important directions for obtaining correct posture are:
......17. Hold chin up.
......18. Hold shoulders up.
......19. Throw chest out.
......20. Grow tall.

VI. The lovely symmetry of the body is developed day by day throughout the years of life by habit postures such as:
......21. Standing with the weight on one foot.
......22. Hands on hips, with abdomen thrust into prominence.
......23. Hips forward, arms folded on abdomen.
......24. Relaxing of muscles of shoulders and contracting chest muscles.

UNDERWEIGHT AND OVERWEIGHT

VII. The most sensible treatments for underweight are:
......25. Hard work.
......26. Eating plenty of food containing protein.
......27. Living under a nervous strain.
......28. Refraining from eating food containing starches, sugars, and fats.

VIII. Underweight usually leads to:
......29. Increased physical efficiency.
......30. Necessity for strenuous exercise.
......31. Increased appetites.
......32. Low blood pressure.

IX. Overweight if more than slight may be due to:
......33. Disparity between intake of food and its metabolism.
......34. Endocrine origin.
......35. Eating plenty of foods containing roughage.
......36. Perpetual, insatiable appetite.

X. Type of diet for reducing is one which:
......37. Contains large proportion of bulky foods.
......38. Includes plenty of salads and fruits.
......39. Prohibits absolutely eating between meals.
......40. A variety of food is eaten, but there is a decrease in total amount.

COLDS AND INFECTIONS

XI. Bacteria produce:
......41. Local damage at the point where they enter the body.
......42. General damage.
......43. Purulent exudation.
......44. Structural damage.

XII. Venereal diseases do not cause:
......45. Disease of the heart.
......46. Sterility.
......47. Insanity.
......48. Danger to individual life, or menace to others.

XIII. Some individuals have been cured of a tendency to colds by:
......49. Removal of tonsils.
......50. Reducing the temperature of the rooms in which they spend most of the time.
......51. Vaccines.
......52. Freedom from constipation.

XIV. The individual with a cold should learn to:
......53. Isolate himself.
......54. Prevent his bacteria from getting into surrounding atmosphere.
......55. Keep his infected hands away from articles used by others.
......56. Feel privileged to stand close to people while talking.

HYGIENE OF EATING

XV. One may influence digestion for the better by:
......57. Eating when hungry other than at meal times.
......58. Omitting meals when not hungry at meal times.
......59. Eating candy and sweets between meals.
......60. Practicing idiosyncracies.

XVI. Some of the disorders of peculiar appetites that should be investigated are:
......61. Lack of appetite.
......62. Inordinate appetite.
......63. Craving for certain articles of diet to the exclusion of others.
......64. Lack of appetite followed by inordinate appetite.

XVII. Too small amount of food leads to:
......65. Digestive trouble.
......66. Malnutrition.
......67. Constipation.
......68. Gas formation and distention of the abdomen.

BATHING

XVIII. Good effects to be expected from a cold shower are:
......69. Increases metabolism.
......70. Improves muscle tone.
......71. Cleanliness.
......72. Stimulation of nerve endings in surface of skin.

XIX. A cold shower should be taken:
......73. At night before retiring.
......74. After a warm bath following exercise.
......75. To "jazz up" a tired personality.
......76. Soon after rising.

XX. The temperature of a warm bath should be:
......77. 60-70 degrees Fahrenheit.
......78. 70-80 degrees Fahrenheit.
......79. 90-98 degrees Fahrenheit.
......80. 100-105 degrees Fahrenheit.

Sleep and Rest

XXI. Classification of persons who do not get enough sleep are those:
......81. Affected by toxins.
......82. Who exhaust themselves physically and mentally.
......83. Whose bodily processes are slow.
......84. Who sleep under poor conditions.

XXII. Difficulties in going to sleep are due to:
......85. Too little blood in the brain.
......86. Fear of not falling asleep.
......87. Lack of determination.
......88. Maladjusted restless life.

XXIII. Factors which promote sleep are:
......89. Reasonable fatigue.
......90. Habit.
......91. Outdoor exercise.
......92. Full stomach.

Menstrual Hygiene

XXIV. Dysmenorrhea (painful menstruation) is frequently accompanied by:
...... 93. Sagging or misplaced organs.
...... 94. Weak abdominal muscles.
...... 95. Constipation.
...... 96. Pelvic congestion.

XXV. The painful menstruation so commonly observed is in a large number of cases, congestive in type and is produced by:
...... 97. Use of diaphragm and abdominal muscles in breathing.
...... 98. The lack of general muscular development.
...... 99. Activity during menstrual period.
......100. Psychic influences.

XXVI. Mental attitudes and habits that play a disastrous part in preventing woman's freedom are:
......101. Thinking in terms of health.
......102. A clean, perfect functioning mind.
......103. Considering a woman's life in terms of menstruation.
......104. Discarding of "sick time" and "unwell" from vocabulary.

Mental Hygiene

XXVII. Mental training includes training in:
......105. Removal of unwholesome states.
......106. Substitution of thought.
......107. Depression over past mistakes, in order to promote practical thinking.
......108. Substitution of purposes.

XXVIII. The normal life flows from:
......109. Fears and worries.
......110. States of "satisfyingness."
......111. Long range apprehensions.
......112. Optimism to pessimism.

Food and Diet

XXIX. Some factors that influence malnutrition are:
......113. Eating too little.
......114. Health conditions unfavorable to the utilization by body cells of adequate diet.
......115. Faulty habits of living.
......116. Focal infections.

XXX. Greater energy needs of the body may be most easily met by an increase in:
......117. Vitamins.
......118. Proteins.
......119. Minerals.
......120. Starches and sugars.

XXXI. Foods should be chosen solely:
......121. On a caloric basis.
......122. For production of heat and energy.
......123. According to proportion of carbohydrates, calcium, and fats.
......124. For bulk and vitamins.

(E.N.: The other test forms have been omitted because of space limitations.)

An Analysis of the Speed Factor in Simple Athletic Activities

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THIS study has been conducted in an effort to isolate and identify the various factors which govern the speed of muscular movement in man. In an attempt to study speed relationships in athletic performances one soon discovers the complexity of the situation. In the first place a given athlete will not exhibit the same speed performance from day to day. This can be accounted for to a large degree by daily variations in physiologic condition. The mental attitude of the performer also has an important effect on the end results.

In an attempt to analyze speed into its more basic elements, several theories have been advanced. Hill[4,5]* and his co-workers have placed the limiting value of speed of movement on the viscosity of the muscle substance. Hill defines viscosity as the internal resistance generated by the muscle as it contracts, the resistance being due to the flow of molecular parts into new and different configurations. Hill has shown that the actual work done by a human muscle in shortening can be expressed as a simple function of speed, the actual work accomplished becoming less as the speed of contraction becomes greater. More attention will be given to his work in another section of this study. Steinhaus believes that an increase in speed can be brought about by an increase in strength, although he admits that strength and speed are not directly proportional to each other.[9] This, he explains, is because a portion of the strength must be devoted to overcoming the internal resistance to changes in the muscle itself, and also to the fact that the viscosity factor increases rapidly as the time of shortening is reduced. Therefore, more and more of a muscle's strength is devoted to changing its own shape as its speed of contraction increases. According to Steinhaus the ultimate in speed is attained when the inertia of the enlarging bulk of muscle, which accompanies each increase in strength, uses up the added strength it provides. Steinhaus states that in order to obtain the highest in speed this increased strength must be guided by skill.

The above interpretations may account in part for speed variations, but it seems reasonable to believe that such a complex phenomenon as this depends on a combination of these and other basic components. If

* Indices refer to Bibliography at end of article.

the basic elements which combine to form the speed complex could be isolated and determined both qualitatively and quantitatively the problem would be simplified.

If we do assume that a given speed performance is a complex of certain basic physical components the question arises as to how we may differentiate and measure them. In the field of psychology, Thurstone has recently developed a method of multiple factors by the use of which he has been able to isolate those elements of intelligence which are in some fundamental sense primary.[10,11] Although the multiple factor methods have been developed primarily for the solution of psychologic problems, these methods are applicable to the biologic and social sciences and may readily be used in an effort to isolate the primary elements of speed.

If, for example, an athlete were tested on a series of speed events which called into action only the same fundamental abilities, then we could not expect to differentiate these primary components or abilities. On the other hand, if these events required different fundamental abilities then it may be possible, by Thurstone's method of multiple factors, to differentiate and isolate these primary abilities. The performance of the individual in the various tests would be determined in part by the abilities that are called for by these tests and in part by the degree to which the individual possessed these abilities. Therefore, an individual's performance on a test may be regarded as a sum of the contributions of his primary abilities. The different tests will not call upon the individual's various abilities to the same degree and therefore, each of his performances can be described as a sum of the weighted linear contributions of his different primary abilities. The weights, then, are descriptive of the tests.

This method offers a convenient and comprehensive means of analyzing the data supplied by this study. Although the technique is still in the stage of further refinement and has certain shortcomings, it nevertheless yields a means of analyzing complex problems equaled by few other methods.

STATEMENT OF PROBLEM

The purpose of this study is to analyze statistically a group of athletic and physiologic tests in the hope that certain common elements associated with speed of muscular movement might be isolated. For this analysis, Thurstone's method for determining multiple factors is utilized.

REVIEW OF LITERATURE

A review of the literature shows that studies utilizing the multiple factor methods in physical education are limited.

McCloy in his analysis of the four elements of the General Motor Capacity test isolated three common factors:[7] the first factor, undoubt-

edly, being strength; the second, velocity; the identity of the third being in doubt, but probably something like large-muscle coordination. Pull-up strength was added to the battery of tests and the results indicated that it was composed almost entirely of strength.

McCloy, by a multiple factor analysis of a test battery including weight, classification index, four track and field events, and four strength tests, found three group factors.[8] The first of these was found to be significantly related to all the variables; the second was related to ability in track and field events. The first of these factors was identified as strength and the second as velocity. The third factor was tentatively identified as that part of weight which does not contribute to strength.

In an analysis of tests elements used in physical education, Wendler isolated four common factors.[13] Factor I was identified as strength, and factor II as velocity or speed of movement. Factor III was found to be motor educability or the innate capacity to learn skills involving new combinations of large-muscle coordination. Factor IV was tentatively identified as sensorimotor coordination.

Turning to the physiologic aspects of muscular contraction, Hill states that the work done by a muscle in shortening can be expressed as a simple function of the speed by the equation:[5]

$$W = W_o \ (1 - kv)$$

where W_o represents the work a muscle can do when making the greatest possible effort and when shortening infinitely slowly. Now by giving the muscle a lighter load and allowing it to shorten with speed v, the work W accomplished is found to be less than W_o although the muscle continues to exert maximum effort. In the above equation k is a constant, $1/k$ being the greatest possible velocity of the unloaded muscle. This equation has been verified experimentally by Hill with human arm muscles and expresses a relation which would hold were there a resistance to rapid motion of a viscous character inherent in the muscle. However, Hill adds that it is not to be supposed that the ability of short distance runners is to be found only in a lower muscle viscosity. A higher propelling force (depending on musculature) might produce a champion, just as a lower viscosity might do the same thing.

Recently Fenn has found that for a ratio of shortening of 10 per cent of its length per second, a muscle loses on the average of 3.1 per cent of its tension.[2] A similar constant calculated from the data of Hill gives the larger value of 7.3 per cent, which, according to Fenn, is probably because reflex inhibition contributed to the decrease of tension. It is concluded that 3.1 per cent for shortening represents a maximum figure for viscosity alone. From motion picture films of good runners, Fenn found that the maximum rate of shortening of the biceps femoris, which occurs during the backward swing just before the foot leaves the ground, amounts to 37.3 per cent of its length per second. The loss of

tension due to viscosity at this rate of shortening would amount to 37.3×3.1 or 115 per cent. At this rate of shortening the muscle would be able to exert no external tension.

Fenn concludes that although there is a viscosity factor it is not as much a limiting factor as Hill would lead one to expect.[3] Fenn would ask whether the resisting force which appears to increase in proportion to the velocity of the runner is a real viscosity factor, or merely a conglomeration of opposing influences, depending, for example, on the way in which a runner changes his stride with increasing velocity.

PROCEDURE

Fifty-one male subjects between the ages of eighteen and twenty-four years participated in this study. The group was carefully selected in order to eliminate overweight individuals and those not possessing a high degree of athletic ability. Therefore, only students majoring in physical education and varsity athletes were used. The data were collected over a period of five months and were obtained from a given subject during the training season of his respective sport. The following is the sports distribution of the subjects:

Football	1	Wrestling	2
Basketball	1	Gymnastics	3
Track	36	Baseball	3
Swimming	1	Physical education majors	4

DESCRIPTION OF APPARATUS

In collecting the physiologic data, two distinct types of apparatus were employed; one for measuring the muscle thickening latency of intact muscle and the other for measuring simple reaction time.

The method of measuring muscle thickening latency was the same as that described by Lapp[6] and Beebe.[1] The records of the muscle thickening latency were obtained by photographing the string of a standard Cambridge type galvanometer used in connection with the electrocardiograph. Break stimuli were delivered to the medial motor point of the muscle; a sensitive generator lying in contact with the muscle and wired in series with the galvanometer acted as the response unit for detecting the beginning of muscle thickening. For a detailed description of this technique the reader is referred to the study by Lapp.[6]

The action currents in the muscle were obtained by placing action current electrodes (two copper plates ¾″×3″ covered with canton flannel and moistened with saturated saline solution) on the body of the reacting muscle with the electrodes approximately one quarter of an inch apart. The action currents in themselves were too weak to influence the string so they were stepped up by means of an amplifier. A storage battery and two B-batteries supplied the current for the amplifier. From the amplifier the leads ran to the string of the electrocardiograph.

In order to measure the velocity of a man running at maximum

speed, the apparatus shown schematically in Fig. 1 was employed. Time was measured by a Dunlap chronoscope.

Two standards were placed on the running track approximately 10 yards apart. To one of these standards was attached a mechanical make switch and to the other was fastened a fixed pulley. The make switch (Fig. *1*, *F*) was constructed of two spring brass strips about ¼″ wide and 4″ long attached to a small wood block in such a way that they exerted a slight amount of tension at the extremity which was the only point of contact. At the base of each metal strip a wire was attached which connected the switch with the chronoscope. A small piece of insulating fiber was placed between the ends of the metal strips thus keeping them apart. To this fiber was attached the finish yarn which was run through the pulley on the other standard. In order to keep the tension on the yarn constant a weight, just heavy enough not

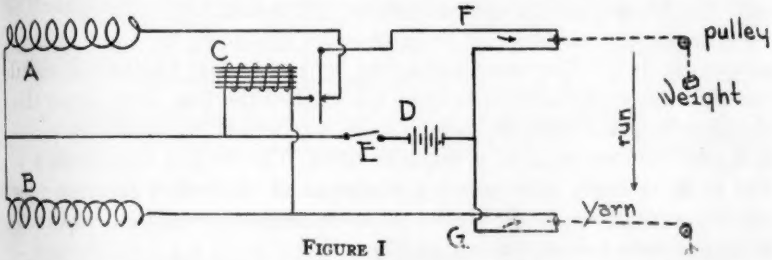

FIGURE I

FIGURE 1. The arrangement of the apparatus used for recording running speed.

to pull the insulated fiber from the make switch, was attached to the yarn just below the pulley. The sensitivity of the device was demonstrated by the fact that only the slightest tap was necessary to pull the fiber from the make switch, thus allowing contact to be made at this point. At exactly ten yards distance from this piece of apparatus a duplicate device was set up. The height of the switch and pulley could be regulated so that the yarn extended across the track at about the height of the subject's hips. This height was considered best as the danger of the subject's arms striking the yarn was less than if it were placed higher.

The apparatus as used with the chronoscope worked as follows: Switch *E* is closed. The runner strikes the first yarn, pulls the insulated fiber from switch *F*, thus making contact at this point. This completes the battery circuit *D* and makes contact with the "go" coil *A* starting the chronoscope. When the runner strikes the finish yarn the insulated fiber is pulled from the switch *G* making contact at that point. The circuit through the electro-magnet *C* is now closed thus throwing the "go" coil *A* out of the circuit. At the instant contact is made at switch *G* the "stop" circuit *B* is completed and the chronoscope is stopped. The readings were taken to thousandths place, but rounded off to the nearest hundredth.

The remainder of the apparatus used in collecting the athletic data is in general use in physical education testing programs, thus making a description of it unnecessary.

COLLECTING THE DATA

The procedure for collecting the data is discussed in the same order in which it was carried out in the laboratory.

Physiologic Data

A. *Reaction Time of the Triceps Muscle.*—The subjects were seated comfortably on a stool with the right arm extending over, and supported by a padded iron bar, shoulder high. The position was such that a light could be readily seen and a response elicited the moment the light flashed. To minimize the effect of distracting auditory stimuli, a water tap in the room was allowed to run and the door connecting the experimental with the recording rooms was closed. The electrodes were placed over the triceps muscle approximately ¼″ apart.

The subject was directed to respond by extending his right forearm as quickly as possible upon seeing the light stimulus. The verbal signal "ready" was given before the light was flashed the first time. After this the time interval between light flashes was varied to avoid the possibility of the formation of a response habit. The subject was given several practice trials after which a minimum of thirty-five reaction time records were taken. In the treatment of these data the median was used. A sample record is reproduced in Fig. 2, 1.

B. *Reaction Time of the Gastrocnemius Muscle.*—The subjects were directed next to assume a comfortable prone position on a padded table with the legs extending over the edge. A stirrup prevented sideward movement of the right leg. The electrodes were placed over the gastrocnemius muscle of the right leg approximately ¼″ apart. Each subject was instructed to extend the right foot as quickly as possible upon seeing the flash of the stimulus light. The rest of the procedure was the same as that described for the reaction time of the triceps. A sample record is reproduced in Fig. 2, 2.

C. *Muscle-Thickening Latency of the Gastrocnemius Muscle.*—The subject was instructed to keep the same position that he had assumed for the reaction time of the gastrocnemius muscle. The motor point was determined experimentally and the apparatus adjusted with the response unit resting on the thickest portion of the gastrocnemius muscle. Twenty muscle thickening latency records were then taken although in some cases photographic difficulties reduced the number of readable records. A sample record is reproduced in Fig. 2, 3.

D. *Muscle-Thickening Latency of the Triceps Muscle.*—The subject was directed to assume a semi-reclining position resting his hips on a high stool with his chest and his right upper arm flat on the table and his forearm hanging over the edge of the table. A stirrup, which

was well padded, prevented sideward movement of the right arm. The motor point was determined experimentally and the apparatus adjusted

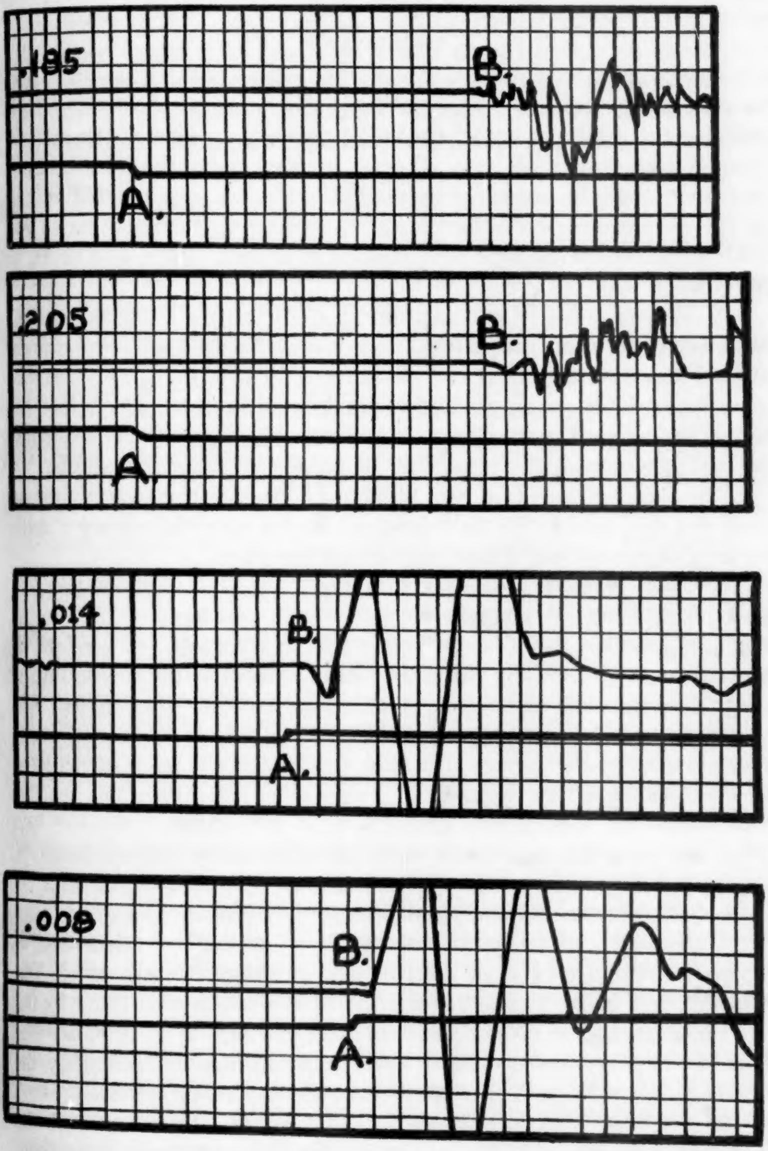

FIGURE 2. Sample records. In each record, *A* is the stimulus and *B* is the beginning of the response. Time in 1/100 seconds. 1. (Top) Reaction time of the triceps (.185 sec.). 2. Reaction time of the gastrocnemius (.205 sec.). 3. Gastrocnemius thickening latency (.014 sec.). 4. Triceps thickening latency (.008 sec.).

with the response unit resting on the thickest portion of the triceps muscle. Twenty records were taken for each subject. A record of the triceps response is reproduced in Fig. 2, 4.

Athletic Data

Due to daily variations in athletic performances it was thought best to collect data on each of the athletic events on two separate days, utilizing the results of both days in the analysis. In each of the athletic tests at least three trials were allowed; in cases where the third attempt was better than the preceding ones, additional trials were granted as long as the performance continued to improve. During participation in the athletic events the subjects were clothed in trunks, jersey, and shoes, in accordance with the event.

A. *Sprints.*—Before participating in the trials the subjects were instructed to warm up adequately. Each runner, using a sprinter's stance, started at a distance exactly 20 yards from the first yarn. This distance gave the sprinter ample yardage to reach maximum velocity before entering the 10-yard zone. The total distance of 30 yards was also short enough to eliminate the possibility of fatigue effecting the results.

The time for each trial was tabulated, but only the fastest time on each day was used in the calculations. Careful observations were made to see that the sprinter's hips only struck the yarn.

B. *Light Shot-Put.*—A shot weighing 4 lbs. was used for the purpose of reducing the strength element of the extensors of the arm as much as possible. An attempt was made to eliminate the element of putting form by carefully instructing each subject in the method to be used. The put was made from a standing position. The subject was permitted to follow through after the put and step outside of the ring thus eliminating the reverse. The shot was held in the palm of the hand which eliminated the technique of wrist snap and finger flip. In this experiment the subject was given at least four trials. Only the best effort was recorded, measurements being taken to the nearest inch.

C. *Hand Dynamometer.*—In testing the grip strength, the Smedley hand dynamometer was employed. The subject was allowed a few practice trials to acquaint himself with the "feel" of the instrument and to adjust the distance between the two bars to the size of the hand. The subjects were instructed to prevent the dynamometer and the gripping hand from coming in contact with the body during the experiment. The subject was given a minimum of three trials with each hand. Only the best trial for each hand, on a given day, was recorded.

D. *Back and Leg Dynamometer.*—In testing the strength of the back and legs, the back, leg, and chest dynamometer devised by Freeman was used.

1. *Back Strength.*—The subjects were instructed to stand with the legs straight and the back bent to an angle of approximately 60°. The

chain on the dynamometer was adjusted to the proper height and the subjects were told to lift upward with all their power.

2. *Leg Lift.*—In the leg lift the subjects' knees were flexed, the back being straight with the handle of the dynamometer resting across the upper thighs. The hands were held close together on the handle, between the thighs next to the chain. The optimum bend of the knee to produce the best lift was determined experimentally by raising or lowering the handle during the practice trials. Readings on the dynamometer

TABLE I

A Summary of Means and Standard Deviations for All Experiments as Indicated

	Event	Mean	S. D.
1	Sprint (1)	1.0441 sec.	.0531 sec.
2	Sprint (2)	1.0457 sec.	.0527 sec.
3	Sargent Jump—Arms (1)	58.7843 cm.	7.9245 cm.
4	Sargent Jump—Arms (2)	58.3922 cm.	7.9729 cm.
5	Sargent Jump—Not Arms (1)	47.2941 cm.	6.7223 cm.
6	Sargent Jump—Not Arms (2)	47.2353 cm.	6.9778 cm.
7	Hand Dyna—Right (1)	56.0980 kg.	7.9567 kg.
8	Hand Dyna—Right (2)	58.0784 kg.	8.2627 kg.
9	Hand Dyna—Left (1)	53.0392 kg.	7.4149 kg.
10	Hand Dyna—Left (2)	53.9020 kg.	7.3515 kg.
11	Back Lift (1)	407.4510 lb.	85.2410 lb.
12	Back Lift (2)	412.3529 lb.	79.6462 lb.
13	Leg Lift (1)	565.8824 lb.	128.0037 lb.
14	Leg Lift (2)	571.7607 lb.	127.5210 lb.
15	Shot-Put (1)	48.1451 ft.	5.5738 ft.
16	Shot-Put (2)	48.1784 ft.	5.6926 ft.
17	Muscle Thick—Gastrocnemius	.01443 sec.	.00390 sec.
18	Muscle Thick—Triceps	.01337 sec.	.00510 sec.
19	Reaction Time—Gastrocnemius	.2259 sec.	.0169 sec.
20	Reaction Time—Triceps	.2044 sec.	.0350 sec.
21	Height	176.3137 cm.	6.0706 cm.
22	Weight	70.3510 kg.	7.9927 kg.

were taken to the nearest 10 pounds. Only the greatest lifts for the back and for the legs on each day were recorded.

E. *Sargent Jump.*—The jumps were made without shoes, on a tumbling mat. Each subject was carefully instructed in the form of the Sargent jump. Practice trials were given until the subject gave indications that he had mastered the technique of the arm swings. After sufficient rest, the individual was given a minimum of four jumps. Only the best mark of this day's trials was recorded.

The subject was given a few minutes' rest before attempting the Sargent jump without the use of the arms. In this jump the subject was instructed to hold on to the belt front of his trousers during the whole course of the jump. The individual was given the same freedom of bending the trunk and the legs as was allowed in the regulation Sargent jump, the only difference being in the elimination of the use of the arms. A minimum of four jumps was given each subject. Only the best mark of the day's trials was recorded.

TABLE II

Table of Intercorrelations

		1	2	3	4	5	6	7	8	9
22	Weight	—.3363	—.0392	.1514	.1980	.0993	.0611	.5655	.4810	.4817
21	Height	.3115	.2527	.3129	.2923	.1535	.1107	.4469	.5301	.3670
20	Reaction Time—Triceps	—.1331	—.0803	.0747	.0606	.1348	—.0765	—.0657	—.0432	—.1223
19	Reaction Time—Gastrocnemius	—.1559	—.1138	.0181	.0258	—.0254	—.1073	—.0123	—.0742	—.0467
18	Muscle Thick—Triceps	.1916	.1936	.0872	.1492	.1233	.1347	—.0399	.0709	.0112
17	Muscle Thick—Gastrocnemius	.2062	.1976	.1023	.0247	—.0108	—.0056	—.0018	.1458	.0326
16	Shot-Put (2)	.4878	.3764	.3552	.4324	.3132	.4113	.3414	.3996	.4361
15	Shot-Put (1)	.5389	.4608	.3359	.3991	.3301	.4211	.3465	.3438	.3964
14	Leg Lift (2)	.0675	—.0758	—.0196	.0541	.1241	.0324	.2352	.1769	.2405
13	Leg Lift (1)	—.0671	—.1490	.0795	.0119	.2079	.0595	.2528	.1772	.3609
12	Back Lift (2)	.1828	.0746	.2344	.2619	.3148	.3021	.2806	.4023	.5065
11	Back Lift (1)	.1139	.0050	.2314	.1746	.2994	.2252	.3401	.3939	.5468
10	Hand Dyna—Left (2)	.1866	.0275	.2820	.2180	.2390	.3073	.6753	.7251	.8223
9	Hand Dyna—Left (1)	.2630	.0927	.2438	.2564	.2028	.2659	.6982	.6622	
8	Hand Dyna—Right (2)	.2409	.1570	.2950	.2772	.1938	.2878	.8115		
7	Hand Dyna—Right (1)	.1746	.0040	.2296	.2120	.1678	.2362			
6	Sargent Jump—No Arms (2)	.6938	.6275	.7257	.7800	.8208				
5	Sargent Jump—No Arms (1)	.6273	.5637	.8519	.7043					
4	Sargent Jump—Arms (2)	.6436	.6423	.8011						
3	Sargent Jump—Arms (1)	.6144	.6120							
2	Sprint (2)	.8814								
1	Sprint (1)									

TABLE II

Table of Intercorrelations (Continued)

	10	11	12	13	14	15	16	17	18	19	20	21
(22)	.5412	.4622	.4377	.4134	.5043	.5224	.5788	—.0305	—.0692	.1257	.2692	.6411
(21)	.4026	.2312	.1940	.0302	.0274	.5311	.5525	.3271	.1473	.0158	.2625	
(20)	—.0004	.0187	.1015	.1956	.1203	.0052	.0089	.0279	.1357	.3344		
(19)	.0019	—.0060	.0167	.1665	.2161	.0211	—.0295	.0933	.2213			
(18)	.0759	.0740	.1030	.0246	.0154	.1553	.2153	.5645				
(17)	.0567	.0020	.0841	—.1087	—.0942	.1265	.1652					
(16)	.4634	.3595	.3505	.2746	.2511	.8957						
(15)	.3564	.3875	.3511	.2901	.2900							
(14)	.2819	.4914	.5761	.6759								
(13)	.4054	.7008	.5760									
(12)	.5894	.8049										
(11)	.5669											

F. *Height.*—Height was taken with the feet bare and recorded to the nearest centimeter.

G. *Weight.*—Weight was taken in the nude and recorded to the nearest tenth kilogram.

A summary of the means and standard deviations for all experiments is shown in Table I.

MULTIPLE FACTOR ANALYSIS

Pearson product-moment correlations were obtained for each test against each of the other tests. The intercorrelations are shown in Table II. These intercorrelations were used as the foundation for the correlation matrix, which, in turn, became the data sheet for computing the first factor loadings. Beginning with the correlation matrix data sheet, the unrotated factor loadings for the first six factors were obtained. Thurstone's multiple factor method was followed throughout.

The above procedure, although successful in isolating the common factors, does not reveal the identity of the factors. The process of identification of the factors is carried out by a procedure known as rotation of the axes. Although there is an infinite number of possible rotations or of solutions for a factorial matrix, the one sought is that which most logically describes the factors in the light of the variables.

In order to identify the factors, the problem is to rotate the configuration into a unique position with reference to the coordinate axes so that the axes (the factors) shall be scientifically and logically meaningful. The unique solution is usually attained when the factorial matrix has been so rotated that the number of zero entries is maximized and so that the non-vanishing entries are positive or as nearly in the positive quadrant as can be attained.

The factorial matrix involved in this problem was of rank six and, therefore, in six dimensions. In order to simplify the process of rotation in this matrix of six dimensions, a graph method was used in which the test items were plotted against only two of the coordinate axes at a time. By keeping the matrix in two dimensions at any given time a more simplified and concrete picture of the factorial matrix in regard to the axes was obtained. The process, of course, involved the shifting of the variables from one plane to another since the position of the variables for each factor was plotted against that of each of the other factors. Since the matrix was of the sixth rank, fifteen graphs were essential to represent the variables in relation to the six factors. The angle of rotation each time was measured and from this, the new factor loadings were obtained which in turn, determined the new graphical position of the variables to the newly established coordinate axes. The amount of rotation made each time depended on the position of the variables to each other and to the coordinate axes, the aim being to maximize the zero entries and to move the non-vanishing entries into the positive quadrant.

RESULTS

The unrotated factor loadings of the first six factors as obtained by Thurstone's method are tabulated in Table III. The rotated factor loadings or zero-order correlations of each test with each of the six factors are presented in Table IV. The column labeled hypotenuse gives the square root of the sum of the squares of the six factor loadings and constitutes a check on the computations. The hypotenuse also represents the correlation of the variables with all of the factors and corresponds to a multiple correlation of the factors with a given variable. A study of the weightings of the factor loadings in relation to the variables acts as a guide in revealing the identity of the factors.

In analyzing the data, factor I was identified as general strength. The back lift and leg lift, two trials each, were at the top of the list with factor loadings of .8136, .7990, .8191, and .7251 respectively. The shot was only moderately weighted with the strength factor, having loadings of .4327 and .4176. This would appear to be slightly low as

TABLE III

UNROTATED FACTOR LOADINGS

	I	II	III	IV	V	VI	Hypotenuse
1 Sprint (1)	.5703	—.6649	.1246	.2061	.2330	.0176	.9381
2 Sprint (2)	.4821	—.7048	.1359	.0791	.0491	—.0656	.8719
3 Sargent Jump— Arms (1)	.6441	—.4525	—.1503	.2665	—.3494	—.0476	.9152
4 Sargent Jump— Arms (2)	.6413	—.4712	—.0894	.1715	—.2923	—.0910	.8742
5 Sargent Jump— Not Arms (1)	.6283	—.4335	—.3174	.3151	—.2264	.—1394	.9238
6 Sargent Jump— Not Arms (2)	.6151	—.5166	—.0774	.3729	—.1037	—.0683	.8974
7 Hand Dyna—Right (1)	.5785	.3870	.4139	.2037	—.2203	.2291	.8934
8 Hand Dyna—Right (2)	.6437	.2900	.3840	.1937	—.1339	.3135	.8942
9 Hand Dyna—Left (1).	.6445	.3612	.3269	.3204	.1187	.1707	.8937
10 Hand Dyna—Left (2).	.6938	.4108	.1986	.2347	.0417	.2025	.8873
11 Back Lift (1)	.6232	.3983	—.2355	.1980	.3233	—.1632	.8791
12 Back Lift (2)	.6509	.3389	—.3049	.1525	.3113	—.1082	.8738
13 Leg Lift (1)	.4551	.4799	—.3849	.0077	.2491	—.2038	.8303
14 Leg Lift (2)	.4118	.4137	—.2713	—.0497	.2504	—.2372	.7320
15 Shot-Put (1)	.7234	—.1436	.3094	—.3037	.1957	—.3019	.9280
16 Shot-Put (2)	.3759	—.1233	.3294	—.3196	.1674	—.2391	.9233
17 M. T.—Gastrocnemius.	.2088	—.2032	—.0229	—.3978	.1519	.4605	.6919
18 M. T.—Triceps	.2716	—.2235	—.2421	—.3899	.1748	.4750	.7685
19 Reaction Time— Gastrocnemius	.0802	.1257	—.3031	—.3175	—.1592	.1614	.5161
20 Reaction Time— Triceps	.1339	.1503	—.2979	—.3290	—.3298	—.0452	.5901
21 Height	.5847	.0600	.3737	—.3457	—.2236	.0294	.8097
22 Weight	.5776	.5215	.1004	—.2685	—.2275	—.3458	.9269

TABLE IV

ROTATED FACTOR LOADINGS

	I	II	III	IV	V	VI	Hypotenuse
1 Sprint (1)	—.0290	.7608	.3868	.1108	—.3703	.0408	.9382
2 Sprint (2)	—.1186	.7555	.3901	.0115	—.1506	.0093	.8717
3 Sargent Jump—Arms (1)	.1102	.8625	—.0089	.2416	.1479	.0139	.9146
4 Sargent Jump—Arms (2)	.1132	.8292	.1042	.1766	.1469	.0121	.8742
5 Sargent Jump—Not Arms (1)	.2267	.8794	—.1192	.1148	.0354	.0055	.9238
6 Sargent Jump—Not Arms (2)	.0911	.8545	.0613	.2133	—.1181	—.0588	.8973
7 Hand Dyna—Right (1)	.2967	.0123	.2380	.7900	.1563	—.0750	.8938
8 Hand Dyna—Right (2)	.2828	.0910	.2812	.7927	.0589	.0314	.8945
9 Hand Dyna—Left (1)	.4447	.0557	.2456	.7050	—.1811	—.0892	.8938
10 Hand Dyna—Left (2)	.5222	.0663	.1815	.6867	—.0755	.0282	.8877
11 Back Lift (1)	.8136	.1211	—.0140	.1844	—.2479	—.0085	.8788
12 Back Lift (2)	.7990	.1773	—.0280	.1656	—.2380	.0933	.8737
13 Leg Lift (1)	.8121	—.0234	—.1175	—.0032	—.0905	.0782	.8296
14 Leg Lift (2)	.7251	—.0409	—.0094	—.0401	—.0701	.0327	.7315
15 Shot-Put (1)	.4327	.3508	.7404	—.0009	.0371	—.0366	.9280
16 Shot-Put (2)	.4176	.3307	.7497	.0532	.0621	.0046	.9233
17 M. T.—Gastrocnemius	—.0830	.0590	.3021	.0387	—.0541	.6105	.6919
18 M. T.—Triceps	.0166	.1532	.1778	—.0247	—.0815	.7265	.7683
19 Reaction Time—Gastrocnemius	.1479	—.0501	—.1060	—.0661	.2712	.3909	.5160
20 Reaction Time—Triceps	.2271	.0445	—.1188	—.0268	.4736	.2359	.5901
21 Height	.2295	.1430	.5705	.3089	.3873	.1053	.8094
22 Weight	.7061	—.0493	.2764	.1694	.4869	—.1274	.9271

the shot is generally considered to be primarily a test of strength. However, it should be recalled that a light shot was used, thus probably reducing the strength element. The surprising feature is the low factor loadings obtained for grip strength of .2967, .2828, .4447 and .5222, which would seem to indicate that there might be a factor of arm strength independent of the general strength factor as will be pointed out later. The general strength factor seems to contribute little if anything to the Sargent jump.

The negligible correlations of the general strength factor with the sprint and Sargent jump indicate that strength beyond a certain optimum is not of as much importance in speed events as some would have us believe. The fact that only high quality athletes were used in this

study, who probably had a fairly high strength index, lends support to our belief that strength beyond this certain optimum adds nothing to speed of movement in athletic events. Had a group composed of both athletes and non-athletes been used, the strength factor might have been more important as a factor in speed of performance. The same reasoning will apply to the relatively small weighting of factor I in the shot-put.

Factor II was identified as velocity, or speed of movement. The highest factor loadings were obtained in the Sargent jump, with loadings of .8625 and .8292 when using the arms and .8794 and .8545 when not using the arms. The sprints ranked next with loadings of .7608 and .7555. The shot, as would be expected, contains some of the speed factor, having loadings of .3508 and .3307. The correlation of the velocity factor with the strengths is negligible as it also is with the reaction times and muscle thickening latencies. A negative correlation occurs with weight and only a low positive correlation with height. This factor is probably the chief limiting factor to the speed of muscular movement and would correspond to Hill's viscosity factor.

Factor III was tentatively identified as a height factor. Although the actual identity of this factor is somewhat in doubt this seems to be the most logical possibility. The height factor appears to be somewhat related to sprinting ability as it correlates .3868 and .3901 with the two sprint trials. This relationship would seem to fall in line with the results found by Fenn who analyzed sprinting ability from motion picture films.[8] His findings indicate that good sprinters in striding raise their thighs through a smaller angle and consistently use a longer stride than do poor sprinters. This would seem to indicate that length of leg, which in itself is related to stature, exerts some influence on speed in the sprints. The height factor has a slightly negative correlation with reaction time (indicating the taller the individual the slower the reaction time) which in a measure is substantiated by Travis's study in which he found height to be a significantly related (negatively) to reflex time.[12]

The two trials of the shot are most closely related to the height factor as they show factor loadings of .7404 and .7497. Height would appear logically to be an advantage in effective shot-putting as the shot would then begin its flight at a point farther from the ground. Also, tall boys on the average have long arms which would give the individual a greater distance through which to generate angular velocity before the shot left the hand.

Factor IV is probably best identified as arm strength since the grip strengths top the factor loadings with values of .7900, .7927, .7050 and .6867 respectively. It has a slight but not significant correlation with the back strengths and with the Sargent jump events. The fourth factor

would probably have had a higher relation to the shot event had a twelve-pound shot been used instead of the four-pound shot. Its slight but positive relation to the sprints and Sargent jump is probably due to an action-reaction effect in the arm swings.

Factor V was identified as dead weight or that part of weight which is not included in the active musculature of the body. As one would expect, actual weight with a factor loading of .4869 contains the largest amount of the dead weight factor. The negative factor loadings for the sprints indicate that dead weight acts in opposition to speed performances of this kind. The loadings for the Sargent jump and for the strength tests are low and in some cases negative.

Factor VI was identified as a muscle latency factor. The muscle thickening latency of the triceps is most highly weighted with this factor, having a factor loading of .7265. Closely following is muscle thickening latency of the gastrocnemius with a factor loading of .6105. From the data it would seem that the latency factor exerts little or no influence on speed of movement or speed of contraction of an intact, loaded, tetanized muscle. This is indicated not only by the low correlation of the sixth factor with the sprints but also the low correlation with the Sargent jump and the shot.

Muscle thickening latency is in reality only a measure of the rapidity of the commencement of muscular response after the nerve impulse reaches the motor point. Usual methods of measuring latency of intact muscle in the laboratory utilize unloaded muscles and measure only the twitch contraction as was done in this study. Two muscles might easily have the same latent times for a simple twitch contraction yet when placed under an equal load and responding to an equal tetanizing stimulus might result in different types of tetanic contractions. The one muscle might reach its maximum state of contraction sooner than the other; this might be considered due to Hill's viscosity factor which has been regarded in this study as Factor II, the speed factor. Such an explanation is purely hypothetical.

SUMMARY AND CONCLUSIONS

In an analysis of a battery of athletic and physiological tests for the primary elements which combine to limit man in speed of muscular movement, six common factors were isolated and identified. Some of the factors as shown by the data contribute less than many authorities have previously assumed.

1. The first factor identified as strength seems to contribute little, if anything, to speed of performance when present in quantities greater than a certain minimum.

2. The second factor was identified as a velocity factor or pure speed of muscular movement and might be considered synonymous to

Hill's viscosity factor. From the data presented, this would appear to be the chief factor limiting speed of movement in man.

3. The third factor appeared to be a linear or height factor. It seems to bear some slight relation to sprinting ability although the relationship is not large. It appears to be quite an important factor in adding distance in events which depend on rapid extension of the arm such as shot-putting.

4. Factor IV has been called arm strength as distinct from general strength. It exhibits only a very slight influence on effective performances in the sprint and Sargent jump.

5. The fifth factor was identified as dead weight or that part of weight which is not included in the skeletal musculature of the body. Dead weight appears to act as an opposing force to speed of muscular movements.

6. Factor VI was found to be what may be called latency of muscular response and seems to exert no significant influence on speed of movements.

The results of this study indicate that normal individuals with a high degree of motor ability or skill and an average amount of strength cannot increase their speed of muscular performance to any appreciable extent.

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The Extent of Physical Education in Nursing Schools

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IS THE physical educator ready to pioneer in the field of nursing education? Nursing educators at the present time are engaged in an analysis and study of the curricula of nursing schools on a nation-wide basis. While their curricula study is uppermost in the minds of educators in the field of nursing education, the physical educator should be speaking for consideration of physical education in nursing schools where courses have not been organized. The present study of physical education in the curricula of nursing schools indicates the extent of opportunities for physical educators in nursing education.

After tapping possible sources of information and finding no study has been recorded pertaining to this question, The Cook County Schools of Nursing consented that this study be made. The questionnaire was used as an instrument of inquiry and sent out in April 1937. All schools selected exceed 40 students in enrollment so that the results show a representative sample only for the 598 nursing schools listed by the National League of Nursing Education with enrollments of more than 40 students.

In ascertaining the extent of physical education for all nursing schools, the 127 responses from schools in 29 states and 86 different cities are found to be an adequate sample for schools with enrollment above 60 students. Table I indicates that 65.4 per cent of nursing schools have a physical education program. On the basis of a sampling

TABLE I
Analysis of the Extent of Physical Education in 127 Nursing Schools

	Number	Per Cent
Physical education required	68	53.5
Physical education extracurricular	15	11.9
Physical education required and extracurricular	83	65.4
No physical education	44	34.6
Questionnaires sent out	233	
Questionnaires returned	127	54.5

TABLE II

ANALYSIS OF 105 NURSING SCHOOLS SUPPLYING ENROLLMENT DATA
ENROLLMENT TABULATED BY INTERVALS OF 20 STUDENTS

Interval	40–59	60–79	80–119	120–139	140–179	180–219	220–239	240–279	280–319	320–359	360 380	Total
No. with physical education ..	5	16	24	8	11	5	1	1	1	1	1	74
No. with no physical education ..	4	7	11	3	5					1		31
Schools not listing enrollment .												22

TABLE III

ENROLLMENT ANALYSIS OF NURSING SCHOOLS IN U.S.
TOTAL NUMBER OF SCHOOLS 1,333*

Interval of Enrollment	No. of Schools
Under 40	735
Between 40–59	269
Between 60–80	157
Over 80	172

* Data analyzed from the "Approved List of Nursing Schools" published by the National League of Nursing Education.

error of 12.7 per cent, it is probable that from 52 to 78 per cent of all nursing schools with student enrollments above 60 have physical education. The sampling of schools with student enrollments between 40-59 shows that 55 per cent of schools in this bracket have physical education, but the sample is not large enough to warrant a general statement of these schools as to the probable extent of physical education. Schools with less than 40 students were not sampled.

There were 66 nursing schools that included additional comments in their responses. Four schools with no physical education at present stated they are planning the organization of a physical education department. Two of these will result with the completion of new residences now under construction. A few included the administrative plan of their departmental organization. Most comments, however, concerned the degree of success with which physical education programs are meeting individual school activity needs.

A wide difference of experiences was noted with physical education programs, the most variable conditions of which are: (1) extent of equipment, (2) utilization of facilities at hand, and (3) physical education objectives. For schools with physical education programs, the school-owned equipment ranges from extensive to meager. In schools

with no physical education program, equipment was reported as adequate to entirely lacking.

The use of equipment, also, varies so that a great number of schools with a meager amount of equipment not only utilize facilities at hand but are also supplementing their programs with equipment made available by outside agencies. Only one school with elaborate equipment stated unsuccessful results in the effective use of their facilities. There are twenty schools with physical education programs using their auditoriums, halls, lecture rooms, playrooms, and solariums as gymnasiums. In the analysis, these have been classed as "Gymnasiums" because these schools indicated that their physical education activities were conducted there. Although not architecturally constructed as gymnasiums, they are serving the purpose in a physical education program which may be superior from an educational point of view. The completeness with which gymnasiums are equipped does not serve as a criterion of desirable physical education experiences, although often making possible a wider range of activities which may be conducive to superior educational results if effectively utilized.

The information supplied by the nineteen questions contained in the questionnaire is presented in detail in Tables IV to XVI with no attempt to comment at length on the data tabulated.

Those nursing schools requiring physical education and using their nursing staff as physical education instructors are included under "School Staff." Although the nursing faculty instructors are not employed as physical education instructors, they are employed by the school, and a portion of their time is devoted to physical education instruction.

TABLE IV

Analysis of Gymnasium and Pool Facilities

A. In Schools with Physical Education

	Gymnasium	Pool
Facilities on premises	59	22
Facilities off premises	18	27
No facilities	4	33
Not stated	2	1
Total number of facilities on and off premises	77	49

B. In Schools without Physical Education

	Gymnasium	Pool
Facilities on premises	8	2
Facilities off premises	3	5
No facilities	22	25
Not stated	11	12
Total number of facilities on and off premises	11	7

C. Total Facilities of A and B combined in 127 Nursing Schools—144

TABLE V

Analysis of Other Recreational Facilities

Enumerated by 70 Schools with Physical Education out of a possible 83
Enumerated by 30 Schools without Physical Education out of a possible 44

100 Schools Enumerated Other Recreational Facilities

Facility Listed or Checked by Schools	Total	Listed as: Other Rec. Fac. and Extracurricular		Listed as: Other Rec. Fac. and Not as Extracurricular		Listed as: Extracurricular and Not as Other Rec. Fac.	
		With P.E.	Without P.E.	With P.E.	Without P.E.	With P.E.	Without P.E.
Athletic Field	8			8			
Archery	8	1		5	2		
Badminton	10			3	3	4	
Basketball	29	5	1	11	5	5	2
Baseball	17	2		15			
Bowling	6		1	4		1	
Billiards	1			1			
Croquet	3			1	2		
Hockey	2			2			
Horseshoe	1			1			
Mushball	1			1			
Putting Green	1	1					
Quoits	1				1		
Rifle Range	1			1			
Shuffleboard	3	1		1		1	
Skis	2				1	1	
Ice Skating Rink	3			2		1	
Roller Skating	14			4	3	5	1
Toboggan Sled	1			1			
Table Tennis	17			7	3	6	1
Tennis Courts	96	14	4	55	22	1	
Volleyball	18			10	4	4	
Totals	243	25	6	133	46	29	4

A. The 70 schools with physical education and making enumerations have 187 recreational facilities or 76.9 per cent of the facilities listed.

B. The 30 schools without physical education and making enumerations have 56 other recreational facilities or 23.1 per cent of the facilities listed.

TABLE VI

Physical Education Personnel in 83 Nursing Schools with Physical Education

Physical Education Instructors Employed:			
Full Time	13	School Staff	9
Part Time	24	Outside Agency	7
Hour	23	Not Stated	7
Total	83		

TABLE VII

Analysis of School Staff

Nursing Faculty Instructors	5	Orthopedic Physician	1
University Instructors	3	Total	9

"Outside Agency" personnel are instructors employed by agencies outside the school and whose services the school uses for its physical education classes in those agencies.

The data in Tables IX and X show that 78 per cent of the tests and measurements are given by schools with physical education; therefore, the indication is that schools with physical education are more likely to use tests and measurements than schools without organized physical education.

Of the 60 schools stating the required number of months of physical education, 52 or 81 per cent require physical education from 4 months to 4 years.

Not only are there administrative considerations for the physical educator when planning an activities program in a school of nursing, but there are problems indigenous to the profession of which she must be

TABLE VIII

Analysis of Outside Agencies

Public Parks	3	Board of Education	1
Y.W.C.A.	2	Physical Education School	1
Total	7		

TABLE IX

Analysis of Tests and Measurements Used in 127 Nursing Schools

Schools giving tests and measurements	58
Schools not giving tests and measurements	25
Schools not checking	44
Total number of schools	127
Schools with physical education giving tests and measurements	45
Schools without physical education giving tests and measurements	13

TABLE X

Frequency of Tests and Measurements Used by 58 Nursing Schools

Physical fitness tests	27
Motor ability tests	7
Physical education knowledge tests	11
Posturegraph	18
Pedograph	7
Weight	48
Other anthropometrical measurements	5

TABLE XI

Tabulation of Data Supplied by 127 Nursing Schools on Grading Students for Physical Education

Number of schools grading students for physical education	29
Number of schools that do not grade students for physical education	46
Number of schools that did not check*	32

* If the assumption is made that the 32 schools in not checking this question indicated a negation, then 62 per cent of the schools do not grade.

TABLE XII

FREQUENCY TABULATION OF THE NUMBER OF MONTHS PHYSICAL EDUCATION IS REQUIRED

No. of Months	Frequency	No. of Months	Frequency	No. of Months	Frequency
2	3	6	7	13½	1
3	4	7	1	16	1
3½	1	7½	1	18	1
4	20	8	4	24	2
4½	2	9	5	48	1
5	3	12	2	36	1
	Total Number of Schools			60	

TABLE XIII

FREQUENCY TABULATION OF THE NUMBER OF HOURS PER WEEK PHYSICAL EDUCATION CLASSES ARE TAUGHT

No. of Hours	Frequency	No. of Hours	Frequency	No. of Hours	Frequency
1	25	2	23	4	3
1½	2	3	4	5	2
				6	1
	Total Number of Schools			60	

TABLE XIV

ACTIVITIES MOST BENEFICIAL TO NURSES AS LISTED BY 79 NURSING SCHOOLS

Activity	Frequency	Activity	Frequency
Swimming*	35	Bowling*	3
Tennis*	33	Bridge	2
Dancing*	28	Dinners	2
a) Social		Fencing*	2
b) Folk		Golf*	2
c) Tap		Hobbies	2
d) Natural		Lectures	2
Physical Education*	17	Literary Club	2
a) Light physical exercise		Orchestra	2
b) Self-chosen activities		School Nights	2
c) Rhythmics		Badminton*	1
d) Recreational Games		Biking* (Listed as Outdoor)	1
e) Fancy Marching, etc.		Current Events	1
Glee Club	14	Debate	1
Hiking*	14	Educational	1
Basketball*	13	Games*	1
Corrective Gymnastics*	12	Hockey*	1
Dramatics	12	Home Movies (Projector)	1
Skating*	9	Handball*	1
Outdoor Activities	8	Paddle Tennis*	1
Teas	8	Religious	1
Picnics	7	Soccer*	1
Parties	7	Sunbathing	1
Reading	6	Theatre	1
Book Reviews	3	Weiner Roasts	1
Ping Pong* (Table Tennis)	3	Total	265

* Activities classified as physical education.

cognizant. While the sedentary aspects of modern day living and increased leisure are being widely discussed, physical education has made and is continuing to make its contribution. The nurse, however, does not have in common the sedentary life of the modern business world. For her there is a continuous expenditure of physical energy necessitated by the nature of her profession. The leisure time of the nurse is complicated by irregular hours off duty, while her hours on duty are a constant strain augmented by the emotional discipline inherent in caring for the sick. These are significant problems for the nursing school physical educator. She must utilize the physical tools of physical education in ways that will enable the nurse to do her day's work more effectively and efficiently with a minimum amount of effort and to assure her that her day may be concluded leaving her added energy for leisure time enjoyment.

The total frequency of physical education activities listed as most beneficial to nurses is 67.1 per cent.

The total frequency of other activities listed as most beneficial is 32.9 per cent.

The tabulation in Table XIV does not in any way minimize the importance of activities not under physical education classification but is analyzed only to show the extent of physical education activities listed as most beneficial to nurses, which is the principal thesis of this study.

The concepts of physical education are not altered when considered

TABLE XV
EXTRACURRICULAR ORGANIZATIONS OF 83 NURSING SCHOOLS

	No. of Schools		No. of Schools
Student Council	47	Other Organizations	10
Standing Committee	10	No. of Schools with more than one Organization	15
Physical Education	1	Total	83

Analysis of Other Organizations Listed:

(1) Student Government, (2) Athletic Association, (3) Social Director, (4) School Organization, (5) Student Nurse Committee, (6) Recreational Directors (three), (7) Student Body, (8) Class Organization. Total 10.

Analysis of Schools with more than one Organization:

1. Student Council and Physical Education	3
2. Student Council and Standing Committee	3
3. Student Council and Social Director	3
4. Standing Committee and Physical Education	1
5. Student Council and Women's Board	1
6. Student Council and Cooperative Government	1
7. Student Council and Training School Office	1
8. Student Council and Graduate Nurses Group	1
9. Student Council, Standing Committee, Physical Education, and Class Activities	1
	15

TABLE XVI

EXTRACURRICULAR ACTIVITIES LISTED BY 88 NURSING SCHOOLS

Activity	Frequency	Activity	Frequency
Chorus (Glee Club)	39	Excursions	5
Parties	38	Golf	5
a) Card parties		Current Events	4
b) Monthly parties		Lectures	4
c) Holiday parties		Outdoor Activities	4
d) Informal parties		Crafts	3
e) Class parties		Deck Tennis	3
f) Stunt parties		Library	3
g) Formal parties		Sewing	3
h) Beach parties		Theater Passes	3
Dances	35	Vespers	3
Dramatics	31	Dinners	3
Clubs	22	Hobbies	2
a) Athletic		Nature Study	2
b) Apollo		Year Book	2
c) Book		Astronomy	1
d) Camera		Bicycling	1
e) Literary		Carnival, Yearly	1
f) Poetry		County Fair	1
g) Theater		Debates	1
Dancing	21	Educational	1
a) Tap		Forum	1
b) Modern		Gym Classes	1
Teas	21	Handball	1
Picnics	18	Honor Society	1
Swimming	18	Inter-class Activities	1
Hiking	14	Knitting	1
Social Events	14	Playdays	1
School Paper	10	Professional	1
Musical Programs	9	Scout Troop	1
Orchestra	7	String Ensemble	1
Bridge	6	Sports	1
Horseback Riding	6	Travel Talks	1
Bible Study	5	Tickets to Cultural Program	1
Concerts	5	Weiner Roasts	1
		Total	388

in nursing education. As a way of living, physical education is interested in the educational results obtained from activity. Recognized as an integral part of organized education, it defines this as its unique contribution. To ensure real enjoyment from activity, the teaching of skills is a necessary role of the physical educator. Participation in activity is restricted to the degree that the essential skills are lacking. No one can play tennis who has not learned how to hit the ball. The experience of participation in activities is one of growing satisfactions with increased skill. Whatever skills have been acquired in the physical education classes of the student nurse will contribute to her participation in the extracurricular activities of the school and to her leisure-time enjoyment as a graduate nurse.

(The author wishes to express her appreciation to Miss Alma E. Gault, Acting Director of The Cook County Schools of Nursing at the time the questionnaire was formulated, as well as to Mr. Ira O. Fash who contributed so generously with the statistical compilation.)

The Differential Measurement of Force and Velocity for Junior High School Girls

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PROBLEM

THE purpose of the study was an attempt to determine through experiment what relationship exists between force and velocity in athletic events of various kinds for junior high school girls.

The subjects were students in the East, West, North, and Woodrow Wilson Junior High Schools, Sioux City, Iowa. Tests were made on 163 girls varying in age from thirteen to sixteen, inclusive.

REVIEW OF LITERATURE

The use of the factor analysis in studies of motor performance has not yet appeared extensively in the literature.

A recent study in the Supplement to the Research Quarterly, October 1935, contains a report on "General Elements in Character."[1] This is not a study of motor tests, but illustrates the use of the method. The subjects used for this experiment were junior and senior students in the Physical Education Department of the George Williams College in Chicago, Illinois. Information was collected by a rating sheet, on which forty-three traits of character were listed.

The data were analyzed by Thurstone's center of gravity Factor Analysis method.[2] The first factor was identified as "social qualities"; the second common element was "positive self-feeling"; and the third factor, "individual qualities."

The results of this experiment assume that character qualities may be combined into at least three common components and supplemented by specific elements.

In a recent article entitled, "Factor Analysis Methods in the Measurement of Physical Abilities," it was found that a grouping of variables such as weight, Classification Index, four track and field events, and four strength tests could be analyzed by the multiple factor analysis.[3] This analysis identified three factors that were present—strength, velocity, and weight. (Weight being that part of weight which does not contribute to strength.)

[1] Numbers refer to Bibliography at the end of the article.

A Ph.D. thesis entitled, "A Critical Analysis of Test Elements used in Physical Education" indicates the presence of four underlying common factors in test performance in the field of physical education. Those factors have been identified as (1) strength, (2) velocity, (3) motor educability, and (4) sensori-motor coordination.[4]

In a Master's thesis, "The Differential Measurement of the Speed Factor in Large Muscle Activity," it was found by applying Thurstone's method of Factor Analysis that three factors were present, namely, strength or force, weight, and speed.[5]

PROCEDURE

One hundred sixty-three girls were selected from the senior eighth and junior and senior ninth grade classes, all of whom had had previous experience in physical education activities in their former years in school. The purpose of the test was explained to the girls, and we solicited their interest and cooperation in working out the problem. Only girls who were interested and anxious to do their very best were scored, and it was felt that the reliability of the tests was high due to this fact. These tests were given on the basis of competition between individuals, and schools and results were posted where the participants could see them. This gave an opportunity for comparison and also stimulated each to greater effort.

Each test was demonstrated thoroughly to the participants, and they were given enough practice to have a good knowledge of each test given, its purpose, and results to be obtained. These preliminary tests were given so each girl would have some standard to work toward. Each girl was given two or more tests.

ADMINISTRATION OF TESTS

The Sargent Jump consists in jumping straight upward as high as possible. The measurement is taken from the standing height of the head to the highest point in the jump.

The jump was recorded according to directions in C. H. McCloy's "Measurement of General Motor Capacity," Mimeographed Form.[6] The girl was requested to jump three times, and the jump was measured by subtracting her actual height from the height jumped.

The weight, height, and age of each girl were recorded on her individual record sheet, with records of the other events.

The forty-yard dash was given in the usual manner. Girls started from a crouched position and time of run was taken by stop watch and recorded in seconds. All timing was done by the instructor.

Standing broad jump was given in the gymnasium; mats were arranged so the edge of one could be used as a takeoff to prevent slipping and another upon which the girl could land. Each girl was

given three trials and the best jump out of the three was recorded for that day. All measurements were to the nearest inch.

The obstacle relay from the Master's thesis by Marian Niehaus was used.[7] Timing was done by instructors with a stop watch and pupil assistants were stationed at each point to check on fouls made or failure to complete the stunt.

In the basketball throw, the ball was thrown for distance from behind a line. Each thrower was allowed to make a short run and hop to aid in throwing. Standing back of the line, each individual was given three throws in succession and the best one was recorded to the nearest foot.

The three- and twelve-pound shots were put from a standing position at the front of the circle, with the shot held in the palm of the hand. Any style of delivery was allowed as long as the shot was pushed and not thrown. The different weight shots were given on different days to eliminate any over-exertion on the part of girls, all of whom were inexperienced in this activity. Each individual put the shot three times, and the best records out of three trials were scored. In measuring results, the closest even inch was taken as the official record.

A strength index, composed of the sum of the unweighted strengths of the right grip, left grip, the back lift, the leg lift, and shoulder strength, was used as a test of total strength of each individual. Each girl took these tests three times, several days elapsing between the tests. The Physical Fitness Index was then found by dividing the total strength by the norm for that age.

INTER-CORRELATIONS

The best record made by each individual in each test was tabulated and results were intercorrelated by the Pearson Product Moment Method. The results obtained are given in Table I.

MULTIPLE FACTOR ANALYSIS

Following the above tabulation, an analysis of these data was made by a method of multiple factors; the procedure used was Thurstone's center of gravity method. Three factors only were found. According to this method the factor loadings in the first analysis do not represent true correlations with these factors. The planes of reference must first be rotated. The factor loadings were computed in terms of angles and plotted on the globe, with the result that they fell into three dimensions. Two points were selected through which one plane of reference should fall, and a third point through which a second plane should pass. The rotated or corrected factor loadings are given in Table II.

TABLE I

	Sargent Jump	Dash	Broad Jump	Basketball Throw	3-Pound Shot	12-Pound Shot	Back Strength	Leg Strength	Shoulder Strength	Grips	Strength Index	Physical Fitness Index	Weight	Obstacle Relay
Sargent Jump		.5947	.7313	.5626	.5820	.5309	.2519	.2151	.4195	.3901	.3316	.3750	.0002	.6166
Dash			.5917	.5562	.5406	.4103	.1953	.1936	.2985	.4192	.2865	.2670	.0897	.4616
Broad Jump				.6073	.5990	.4627	.2849	.2489	.4294	.3521	.3566	.4069	.0200	.7294
Basketball Throw					.7247	.7254	.5124	.4391	.5807	.5381	.5886	.4447	.3410	.4823
3-Pound Shot						.6925	.5132	.4734	.5249	.4963	.5915	.4552	.3299	.4793
12-Pound Shot							.6280	.5079	.6292	.6172	.6841	.4502	.5157	.2997
Back Strength								.6225	.5286	.6038	.8438	.6742	.4886	.1945
Leg Strength									.3969	.5217	.9081	.7978	.4124	.1604
Shoulder Strength										.5668	.6384	.4379	.4610	.2886
Grips											.7405	.4588	.6058	.1781
Strength Index												.8079	.5576	.2270
Physical Fitness Index													.0005	.3791
Weight														.1821
Obstacle Relay														

TABLE II

"ROTATED" OR ADJUSTED FACTOR LOADINGS

Factor:	I Velocity	II Weight	III Strength	Hyp.[2]
1. Sargent Jump	.7290	−.2191	.3300	.6883
2. Dash	.6417	−.1501	.2769	.5119
3. Broad Jump	.7752	−.2847	.3271	.7888
4. Basketball Throw	.6127	.1897	.5569	.7214
5. 3-Pound Shot	.6017	.1386	.5545	.6866
6. 12-Pound Shot	.4208	.3517	.6708	.7505
7. Back Strength	.0510	.1879	.8225	.7144
8. Leg Strength	−.0563	−.1449	.8619	.7668
9. Shoulder Strength	.3080	.2569	.6200	.5451
10. Grips	.1671	.1421	.7596	.6249
11. Strength Index	.0001	.0000	1.0192*	1.038*
12. Physical Fitness Index	.0948	−.4076	.7750	.7756
13. Weight	.0002	.5236	.5191	.5434
14. Obstacle Relay	.6966	−.2016	.2375	.5822

*A factor loading of greater than unity is theoretically not possible. When found, it is the result of the Thurstone method of approximating commonalities in the diagonals. It is here assumed to be unity in further computations.

The next step was the identification of the factors found. Our perusal tells us that track and field events are functions of power, which mechanically is composed of force and velocity. Hence in a study of this type one would look for these factors. Furthermore, in the Strength Index, one would not expect to have any velocity in it. This is consistent, as one can see Factor III is a strength factor and that back strength, leg strength, and shoulder strength are all high in this factor and low in the others. Likewise the first factor would seem to be velocity, as all track events are high and strength is relatively low. The second factor would seem upon examination to be weight, which may be defined as that part of the body weight which is not composed of muscle bulk and might be termed "dead weight;" as evidence of this, the highest loading is weight itself; the second factor loadings of all strength events are low, fluctuating around zero; the leg strength weighting is negative, which is consistent, as it means that over-weight reduces recorded leg strength, as it has to be lifted in addition to the "dynamometer strength." Negative loadings were found in all speed events in which the whole body is moved, as in the dash, Sargent Jump, broad jump, and obstacle relay. This again is logical as the greater the "dead weight," the less the efficiency of the body in this kind of event. Finally, the loadings are positive in the throwing events, and in these events, the factor loading is larger in the twelve-pound shot. This is again consistent with the theory that this factor is weight, for a certain amount of "dead weight" minimizes the reaction for that put. So these factors will be considered as velocity, strength, and weight.

The fact that the Physical Fitness Index has a negative correlation with weight is also consistent with the facts, since excess dead weight of the body reduces the Strength Index. For instance, the numerator is decreased, but since the norm in the denominator is based upon actual weight, it increases this norm and hence further reduces the Physical Fitness Index.

Since the factor loadings of the Strength Index are zero in the velocity and weight factors and are unity in the strength factor, it is useless to seek further, and we use the Strength Index as a measure of the strength factor.

This study is concerned primarily with velocity and strength factors and no more consideration will be given at this time to the weight factor. Hence, our next problem is that of measurement, with as great a degree of accuracy as possible, of the velocity factor as such.

A number of combinations were tried, selecting principally those with high factor loadings in velocity or those such as the Strength Index and weight which might be highly correlated with variables themselves. A list of those tried are found in Table III in which the multiple correlations obtained are given.

TABLE III

PARTIAL AND MULTIPLE CORRELATIONS

$R_{0.35\,(11)}$	= .9092	Broad jump; 3-pound shot; Strength Index
$R_{0.36\,(11)}$	= .8924	Broad jump; 12-lb. shot; Strength Index
$R_{0.356\,(13)}$	= .8175	Broad jump; 3-lb. shot; 12-lb. shot; weight
$R_{0.13}$	= .8110	Sargent Jump; broad jump
$R_{0.1245}$	= .8082	Sargent Jump; dash; basketball throw; 3-lb shot
$R_{0.236}$	= .8079	Dash; broad jump; 12-pound shot
$R_{0.125}$	= .8066	Sargent Jump; dash; 3-pound shot
$R_{0.35\,(13)}$	= .8020	Broad jump; 3-pound shot; weight
$R_{0.35}$	= .7939	Broad Jump; 3-pound shot
$R_{0.124}$	= .7908	Sargent Jump; dash; basketball throw
$R_{0.36\,(13)}$	= .7808	Broad jump; 12-pound shot; weight
$R_{0.3}$	= .7752	Broad jump
$R_{0.156\,(13)}$	= .7700	Sargent Jump; 3-pound shot; 12-pound shot; weight
$R_{015.\,(13)}$	= .7675	Sargent Jump; 3-pound shot; weight
$R_{0.156}$	= .7673	Sargent Jump; 3-pound shot; 12-pound shot
$R_{0.15}$	= .7609	Sargent Jump; 3-pound shot
$R_{016.\,(13)}$	= .7306	Sargent Jump; 12-pound shot; weight
$R_{0.245}$	= .7257	Dash; basketball throw; 3-pound shot
$R_{056.\,(13)}$	= .6465	3-pound shot; 12-pound shot; weight

Perusal would indicate first that weight has little significance. For instance, in the case of $R_{0.35}$ and $R_{035.\,(13)}$, weight added nothing of importance. In the addition of Strength Index, a great difference was shown. Multiple regressions were computed for the best combination using strength $R_{0.35\,(11)}$ and for the highest without the Strength Index. The following multiple regression equations were obtained:

(1) Velocity = .8238 (Broad jump) + .8925 (3-lb. shot) − −.0505 (Strength Index) — 7.12

(2) Velocity = .6111 (Sargent Jump) + .6607 (Broad Jump) − 19.8678

The best one $R_{0.85\ (11)}$ using the Strength Index and $R_{0.13}$ in which we did not use Strength Index, make this information usable in institutions having apparatus available for taking strength tests and in those without it.

Owing to the fact that a factor which emerges as a result of the Factor Analysis has no mean and no Standard Deviation, an arbitrary mean of 50 and a Standard Deviation of 10 were used in the above regression equations, which give the results in terms of a T-score. Hence, the average velocity (factor) of this kind of grouping is 50, and each increase or decrease of 10 represents an increase or decrease of one Standard Deviation.

SUMMARY AND CONCLUSIONS

1. The Sargent Jump, dash, broad jump, basketball throw, 3-pound and 12-pound shot, back strength, leg strength, shoulder strength, grips, Strength Index, weight and obstacle relay, a total of thirteen events, were analyzed; and velocity, weight, and strength were obtained as unitary factors contributing to the above events.

2. The Strength Index was found to be almost a perfect measure of strength as a *factor*.

3. A combination of the broad jump, 3-pound shot and Strength Index was found to measure the pure velocity factor to a multiple correlation of .9092.

4. Tests here presented should enable the student of motor tests in physical education to separate the underlying components of motor strength into at least two of their fundamental factors, strength and velocity. At the present stage of the testing movement, this contribution will probably be most utilized by research workers. The techniques devised, however, present a practicable tool for the analysis of a number of skills into their fundamental components and open up new possibilities for more scientific curriculum research.

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BOOK REVIEWS

PHYSICAL EDUCATION FOR THE CLASSROOM TEACHER. Dorothy La Salle. (New York: A. S. Barnes and Company, 1937), 209 Pages. Illustrated, $2.00.

This book should prove valuable in aiding the classroom teachers to make the most of their opportunities of teaching the whole child. It should prove to be a fine textbook in colleges for teacher preparation, and a fine reference book for those already teaching.

In Chapter I the author discusses the needs for physical education: "The test of the worth of any subject is its power to enrich life, its ability to contribute to man's needs, and its potentialities for advancing the common good. . . . In planning, in participating, in suggesting and appraising, the child learns the essentials of cooperative living." Physical education produces great opportunities for guidance of the child in cooperative living.

Chapter II stresses that "Daily teaching must be directed toward specific objectives based upon the larger purposes of education and physical education." The author lists specific objectives for each of the lower grades in a manner that should prove most helpful.

In Chapter III the author explains not only how organization influences results, but also specific organization which offers democratic experiences. The squad system, its application and organization, are given thorough and ample treatment.

Chapter IV. Discussion is given an important place in the physical education program. Talking about situations and analyzing success or failure brings great opportunity for growth under proper guidance. A working plan for discussion is important and is well explained here.

Chapter V. The development of leadership in the child group as well as "followership" which is closely related, should be thoroughly developed by the wise observing teacher. Physical education furnishes great possibilities to develop the traits which are common to all successful leaders.

Chapter VI. The author explains the need for teaching skills to the younger children as well as to the older. Skills not properly learned in the beginning must be unlearned and corrected later. There is detailed analysis given to the fundamental skills of throwing various balls in various ways, and of batting, kicking, and jumping.

Chapter VII gives the analysis of a few typical games at each grade level through the fourth. The teaching situations are pointed out, as well as the desired action for each game. There is a chart classifying each game according to objectives in skills involved. A second chart indicates how teaching situations recur in different games.

Chapter VIII. "The fundamental rhythms are the basic skills of the dance and these should comprise the chief part of the program in the first, second, and third grades. . . . In grades four, five, and six the fundamental rhythms are continued with greater emphasis on composition. Folk dances, clog, and character dances are added." The author, with her wide knowledge of dancing, discusses this subject very helpfully and capably.

Chapter IX. The teaching material in physical education is rich and varied. There are great amounts of professional literature covering games, sports, self-testing activities, rhythms, and dances of all countries. In this chapter, lesson plans illustrating the use of this material and the related equipment are ex-

plained and given in example form.

Chapter X. This chapter is given over to the recapitulation of the foregoing material. "Health, happiness, and character are qualities of first importance and we have seen that physical education may contribute in a large measure. It is the classroom teacher who determines."

At the end of the book, there is an excellent bibliography of games, sports and stunts, dances, and theory. This is followed by a very complete index.

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HEALTH IN COLLEGES. (Proceedings of the Second National Conference on College Hygiene.) President's Committee of Fifty on College Hygiene. (New York: National Tuberculosis Association, 1937). $1.00.

A complete review of this valuable study was published in the October issue of the RESEARCH QUARTERLY, with the price listed as 75c. This price was correct only for orders submitted before publication of the work. The editors wish to make the correction that the book now sells for $1.00.

TECHNIQUE OF UNDERWATER GYMNASTICS. Charles Leroy Lowman, M.D., Susan G. Roen, Ruth Aust, and Helen G. Paull. (Los Angeles: American Publications, Incorporated, 1937), 276 pages, $5.00.

This *magnum opus*, which is sponsored by the Los Angeles Orthopaedic Foundation, represents years of careful research by one of the leading orthopaedists. The title of the book is somewhat misleading as one thinks of the work as dealing only with the water or pool treatment of poliomyelitis. In addition to the above it gives material dealing with the treatment in the water and in the gymnasium for other important bodily defects.

The first part of the book gives a detailed history of the use of physiotherapeutic pools. Next the general theory of the use of underwater gymnastics is considered. This material, as well as other material in the book, contains excerpts from Dr. Lowman's many articles dealing with paralysis, as well as substantial evidence of the authenticity of his theory supported by the writings of many famous orthopaedic surgeons.

The material on the various conditions suitable for hydrogymnastic treatment is carefully developed and lacks any claims for this type of treatment as the only type suitable for these conditions.

Part four is devoted to the field of application for corrective acquatics and is rich in valuable information for physical educators. While stressing the important fact that technicians need careful training in kinesiology, technique and methods of muscle re-education as applied to paralyzed muscles, the material offers physical educators hope that, by careful study, they may do their part in helping the paralyzed to again use his affected limbs.

The book emphasizes the importance of working with a good orthopaedic surgeon while handling cases of paralysis. Excellent material on muscle testing and splendid case reports should enable the trained physical educator to lend his knowledge and skill effectively in the treatment of paralyzed cases.

Many swimming instructors will find this book of great value in assisting them in getting the most out of the use of the pool in the treatment of postural defects. While emphasis is placed on muscle re-education rather than on swimming, as the latter leads to overuse of strong muscles and causes further deformity, the recreational value of activity in the water is not overlooked.

Dr. Lowman and his co-authors are to be congratulated on their contribution to the field of orthopaedics and physical education. Clear cuts and faultless printing make the book a valuable one for all physical educators.

GEORGE T. STAFFORD,
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RESEARCH MEMORANDUM OF EDUCATION IN THE DEPRESSION. Educational Policies Commission. (New York: Social Science Research Council, 1937), 000 pages. $1.00.

"This monograph on research pertaining to education in the depression is one of a series of thirteen sponsored by Social Science Research Council to stimulate the study of depression effects on various social institutions," starts the foreword to this new monograph series.

One of the purposes is "to appraise existing conditions in education critically and to stimulate desirable changes in the purposes, procedures, and organization of education." It is the hope of the committees working out the various sociological aspects of the depression that the violent explosions which accompany economic depressions will be lessened in the future because of the studies of the recent disturbance. Education has probably been more directly affected by this last economic depression than any preceding one.

There has been no definite attempt in this particular publication to relate the facts about the depression and what it did to education, but to raise systematic questions in the field of needed facts. Some of the questions raised are these: What has happened to education in other countries? How do education and schools fare in the several types of political systems when all are submerged in a depression? What shall be the basis for the "good life" for future generations? How shall institutions which control, manage, and disseminate such education be formed? Are educational goals in need of restatement? What shall we teach? What shall we learn? What did the depression do to the curriculum and can the school do anything about it? Was anything really accomplished by the changes?

The monograph stimulates a keen evaluation of the whole educational field and starts a line of thought on the possibilities of what can be done about depressions in the future, should they occur. Or will human nature react as always along the same lines of "we have had depressions before, and will have them again, but if let alone everything will come out all right?"

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THE STORY OF THE OLYMPIC GAMES. John Kieran. (New York: F. A. Stokes Company, 1936), 319 pages. $3.50.

The material in this book is collected and presented from the standpoint of a sports writer. The introductory chapter on Ancient Olympic Games is all too brief. It offered a splendid opportunity for emphasis on the Greek ideal, on the value of legend under the influence of sport upon national life. Throughout the treatment of the entire subject of Olympics there is evident a strong American bias. The title might more properly have been "United States and the Olympic Games." Little space is given to athletes from other countries, though in connection with the first games in 1896 at Athens, full justice is done to Speridon Loues, the Greek shepherd lad, and to the two other Greeks who made a clean sweep of the first three places in the historic marathon.

In connection with the second Olympiad at Paris in 1900, the author makes much of the confusion and poor equipment provided, of lack of interest on the part of the French people and faulty management by French officials producing serious division among athletes from American colleges

The 1904 games at St. Louis, which were held as an adjunct to the World's Fair, were characterized by the predominance of athletes representing athletic clubs rather than colleges. Most events were keenly contested, many records broken and the marathon attracted much attention. The United States won the track and field events more decisively than in any other previous Olympiad, but there were few contestants from abroad.

The interjected games of 1906, held at Athens, saw the first official team

representing the United States. It was selected and financed by the American Olympic committee, the first time American representatives were so chosen. The javelin throw and the pentathlon were added at that time.

Probably the Olympiad involving the greatest number of protests was that in 1908 in London. As a result of the dissatisfaction the control of the contests was for the future placed in the hands of international governing bodies for each particular sport.

The 1912 games at Stockholm represented the Olympics at their best up to that date. A real festival spirit prevailed and in both track and field events the Swedes and Finns showed surprising improvement over their previous performances.

The World War precluded the possibility of Olympics in 1916, which according to plans were scheduled for Berlin, but in 1920 Belgium bravely accepted responsibility and Antwerp welcomed fifteen hundred athletes from twenty-eight countries. The United States for the first time sent representatives from the Army and Navy. In this Olympiad the Finns sprang into prominence by the superiority of their performance, sharing with the United States in eight first places each in the track and field events.

Paris in 1924 welcomed more than two thousand participants from forty-five different countries. The Finns again covered themselves with glory, especially the distance runners. Nurmi was at his best and proved the individual star, winning four races from fifteen hundred to ten thousand meters, and became known to many as "the greatest runner the world has ever seen."

In 1928 at Amsterdam the United States did not show up to expectations, losing the one hundred-meter and two hundred-meter dashes to an unknown Canadian, Percy Williams, a nineteen year old high school boy from Vancouver; and for the first time in the modern Olympics failing to capture the hammer throw and the two hurdle races. An outstanding feature of the Amsterdam games was the distribution of five places in the marathon among five different countries—Algeria, Chile, Finland, Japan, and the United States.

Despite doubt on account of the depression concerning the success of the 1932 games at Los Angeles, that city floated a bond representing a million and half dollars, and the State of California voted a million dollars for the most elaborate preparations ever made for these contests, including an Olympic village of 250 acres with 550 cottages and larger buildings. Athletes were grouped according to the countries they represented. This plan enabled representatives to "mingle with international rivals off as well as on the field." There was a general library and reading room, a large hall in which moving pictures of the events were shown and a special Olympic Village, California, U.S.A., was established as a post office and several issues of special Olympic stamps were provided. The stadium accommodated 105,000 spectators, the auditorium provided for 10,000, while the splendid swimming stadium had sideline seats for 12,000 spectators. In spite of the fact that Europe was far distant and poor and sent few representatives, United States as the home team had more than five hundred competitors. Japan was next with one hundred forty-two, and from that the national representation went by easy steps to a one man team from Haiti and a lone athletic emissary of 400,000,000 Chinese. The 11th Olympiad was noteworthy because of record breaking. Perfect track conditions and ideal weather favored the athletes, and the anticipated prowess of the Japanese in swimming also contributed to provide performances beyond the expectations of the most sanguine.

Much uncertainty arose concerning the 1936 games because of political, social, and racial complications. Yet at Berlin there were registered approximately five thousand athletes from 53 nations. The organizing committee provided facilities surpassing even the splendid equipment of Los Angeles. The Olympic stadium accommodated 110,000.

Spectators to the number of 18,000 were seated in the swimming stadium. The total attendance at the games is placed at four and a half million paid admissions and the cash receipts were the greatest the games had yet produced. The Berlin games proved "a record smashing success for the German organizers and competing athletes." "Record crowds, record receipts, and record performances far exceeded the best previous marks." In sixteen events of the twenty-three in the track and field program, new Olympic records were set and one former record equalled. From the racial standpoint, four negroes won six events for the United States, Jesse Owens being credited with three and an assist.

The author has given a fair account of parts of the Olympic contests. It is a matter for regret that because of the special interest in the United States and the lack of space, the author has admittedly stressed the field and track events, which in reality constitute only one of twenty or more forms of sport recognized in 1936, and it is expected that still other forms, including baseball, may be added at Tokio in 1940.

Swimming has sprung into unusual prominence and would seem to have deserved honorable mention, especially the sensational performances of the Japanese.

Winter sports introduced in 1924 are coming to the fore and promise to claim a large share of interest in the future.

As a source of ready reference the author gives forty pages in summaries to the listing of champions in each event for each Olympiad, including the 1936 games. One more table giving the present records, the names of holders, and the date and place of making the record would have been a valuable addition to this summary. An index of nine pages lists alphabetically the names of competitors, officials, sponsors, indicating the pages where each are mentioned.

Some of the references and suggestions by the author are scarcely calculated to promote international amity, which was a hoped-for result in the mind of the founder Baron Pierre Coubertin.

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Nutrition. The Final Report of the League of Nations Mixed Committee on the Relation of Nutrition to Health, Agriculture, and Economic Policy. (New York: Columbia University Press, International Documents Service, 1937), 327 pages, $2.00.

This comprehensive report is the result of two years' work dealing with the economic aspects of nutrition policy and its relation to agriculture.

The report is divided into three parts: the first gives a general survey of the problem; the second covers the health aspect of nutrition; and the third gives a detailed examination of the economic and agricultural considerations as they relate to the nutritional policy.

"The malnutrition which exists in all countries is at once a challenge and an opportunity: a challenge to men's consciences and an opportunity to eradicate a social evil by methods which will increase economic prosperity."

This world-wide survey of the problem of nutrition will be of value to the many persons teaching "nutrition" as a phase of health education.

The Measurement of Outcomes of Physical Education for College Women. Elizabeth Graybeal, Ph.D. (Minneapolis: University of Minnesota Press, 1937), 80 pages, $1.00.

This study of what the outcomes of a program of physical education for college women are is quite enlightening. Dividing the entering students for two different school years into experimental and control groups, it was found that those who were in the experimental group grew in stature and their attitudes toward activity and games were improved, as well as their skills and knowledge.

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Research Quarterly of the American Association for Health and Physical Education

Numbers refer to: First — Number of issue; Second — Page Number, e.g. 3:114 refers to Number 3 (October), page 114.

Number 1, March; Number 2, May; Number 3 October; Number 4, December.

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